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April 20, 2001

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Ms. Magalie Roman Salas
Secretary

Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Re: Ex Parte Communication in ET Docket No. 98-206; RM-9147; RM-9245; Applications of Broadwave USA et al., PDC Broadband Corporation, and Satellite Receivers, Ltd., to provide a fixed service in the 12.2-12.7 GHz Band; Requests of Broadwave USA et al. (DA 99-494), PDC Broadband Corporation (DA 00-1841), and Satellite Receivers, Ltd. (DA 00-2134) for Waiver of Part 101 Rules.

Dear Ms. Salas,

On April 19, 2001, Sophia Collier and Antoinette Cook Bush of Northpoint Technology, Ltd. ("Northpoint"), and Walter Hanley of the law firm of Kenyon and Kenyon spoke by telephone with Michele Ellison and David Senzil of the Office of the General Counsel.

The purpose of the call was to oppose the request of PDC Broadband Corp. ("Pegasus") for the FCC to accept a license in some allegedly proprietary technology Pegasus claims to possess. Northpoint stated that there is no legal basis for the FCC to take such a license. Pegasus not only lacks any patents on its supposed technology that might form the basis for a license agreement but also has failed to provide any actual technology either to the FCC or to the MITRE Corporation for testing in connection with the above-referenced proceedings, thus obviating any need for the Commission to take a license.

Northpoint cited to *State Industries, Inc., v. A.O. Smith Corp.*, 751 F.2d 1226 (Fed. Cir. 1985), for the proposition that a pending patent application (such as the one Pegasus claims to have) imposes no obligation on third parties and cannot therefore form the basis for a license. *See id.* at 1236 ("Filing an application is no guarantee any patent will issue and a very substantial percentage of applications never result in patents. What

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the scope of the claims in patents that do issue will be is something totally unforeseeable.”). Northpoint also noted that it would be harmed by the grant of a license to Pegasus because the FCC would be creating new rights that do not currently exist in the law as it stands today. This could give Pegasus arguments before the Patent Office and in other proceedings that the FCC has recognized the uniqueness of its technology.

Pegasus claims the FCC needs a license due to written material Pegasus provided to MITRE on February 1, 2001 (see letter from Bruce Jacobs to Magalie Salas, April 10, 2001, submitting copies of letters dated February 1 and 12, 2001 from Pegasus to MITRE Corp). But Pegasus’ request that the FCC take a license in its technology is dated March of 2001, at least a month after the written material was provided. Furthermore, Pegasus subsequently placed the material in the public record at the FCC, effectively waiving any argument that the material represents a trade secret or other proprietary information.

Northpoint and hundreds of other applicants before the Commission have provided thousands of pages of information on their respective technologies to the FCC without seeking that the FCC license the material in order to review it. It would be an extremely poor precedent for the FCC to allow applicants to hold up Commission proceedings while they dicker with the Commission over licensing written disclosures. The FCC has a process for handling confidential material that should be sufficient to protect any legitimate confidentiality concerns that Pegasus may have.

Northpoint asked the FCC to license its technology only when the FCC sought to have MITRE actually use Northpoint’s patented technology. Northpoint did not seek a license for written material, but only for its patented technology. In contrast, Pegasus has not provided any actual technology to be used – only a paper description that is now a part of the public record. Therefore, there is nothing to be licensed.

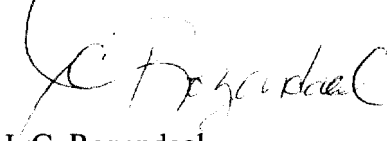
Finally, Northpoint noted that it included a reference to pending patent applications in its license because it had two patent applications that had been allowed and were likely to be issued during the testing process. Those two patents were in fact issued prior to completion of the MITRE test and report. Pegasus’ alleged patents were not similarly issued.

In connection with this conversation, Northpoint faxed to the Office of the General Counsel the following items, copies of which are attached hereto: (1) excerpts from Title 35 of the United States Code; (2) Northpoint’s two most recently issued patents; and (3) a printout of *State Industries, Inc., v. A.O. Smith Corp.*, 751 F.2d 1226 (Fed. Cir. 1985); and (4) Proposed license agreement between Pegasus and the FCC.

Ms. Magalie Roman Salas
April 20, 2001
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Eighteen copies of this letter are enclosed – two for inclusion in each of the above-referenced files. Please contact me if you have any questions.

Yours sincerely,



J.C. Rozendaal

cc: Ms. Michele Ellison
Mr. David Senzil
Mr. Peter Tenhula

TITLE 35. PATENTS

PART II. PATENTABILITY OF INVENTIONS AND GRANT OF PATENTS

CHAPTER 14. ISSUE OF PATENT

35 USCS § 154 (2001)

§ 154. Contents and term of patent; provisional rights

(a) In general.

(2) Term. Subject to the payment of fees under this title, such grant shall be for a term beginning on the date on which the patent issues and ending 20 years from the date on which the application for the patent was filed in the United States or, if the application contains a specific reference to an earlier filed application or applications under section 120, 121, or 365(c) of this title, from the date on which the earliest such application was filed. (emphasis added)

35 USCS § 271

UNITED STATES CODE SERVICE

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*** CURRENT THROUGH P.L. 107-5, APPROVED 3/20/01 ***

TITLE 35. PATENTS

PART III. PATENTS AND PROTECTION OF PATENT RIGHTS

CHAPTER 28. INFRINGEMENT OF PATENTS

35 USCS § 271 (2001)

§ 271. Infringement of patent

(a) Except as otherwise provided in this title [35 USCS §§ 1 et seq.], whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefor, infringes the patent. (emphasis added)



US006208834B1

(12) **United States Patent**
Tawil et al.

(10) **Patent No.:** **US 6,208,834 B1**
(45) **Date of Patent:** **Mar. 27, 2001**

(54) **APPARATUS AND METHOD FOR
FACILITATING TERRESTRIAL
TRANSMISSIONS AT FREQUENCIES ALSO
USED FOR SATELLITE TRANSMISSIONS
TO A COMMON GEOGRAPHIC AREA**

(75) **Inventors:** **Saleem Tawil; Carmen Tawil**, both of
Austin, TX (US)

(73) **Assignee:** **Northpoint Technology, Ltd.**,
Portsmouth, NH (US)

(*) **Notice:** This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) **Appl. No.:** **09/001,766**

(22) **Filed:** **Dec. 31, 1997**

Related U.S. Application Data

(63) Continuation-in-part of application No. 08/731,244, filed on Oct. 11, 1996, now Pat. No. 5,761,605.

(51) **Int. Cl.**⁷ **H04H 1/00; H04B 7/185**

(52) **U.S. Cl.** **455/3.2; 455/13.3**

(58) **Field of Search** 455/3.2, 13.3,
455/427, 430, 12.1, 63, 272, 188.1, 179.1,
562; 348/6, 12, 13; 343/879, 893, 878,
840

(56) **References Cited**

U.S. PATENT DOCUMENTS

D. 195,261 5/1963 McAuley .

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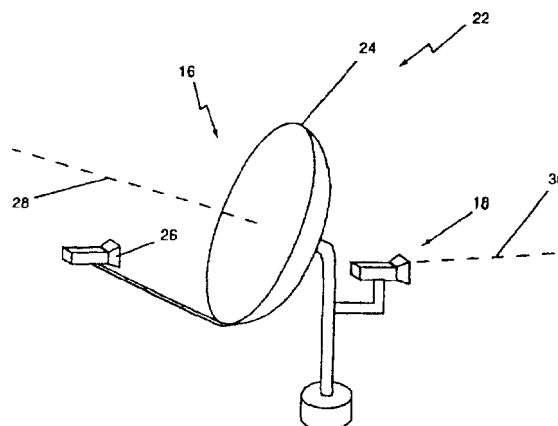
Primary Examiner—Nguyen Vo

(74) *Attorney, Agent, or Firm*—Russell D. Culbertson;
Shaffer & Culbertson, LLP

(57) **ABSTRACT**

A satellite receiving antenna (16) at a user location (14) receives satellite signals at a first frequency from a satellite (12). The satellite signals travel along a satellite signal route (42) within a look angle about the centerline (28) of the antenna (16). A terrestrial transmitter (20) transmits signals at the first frequency along a wireless transmission route (40) from the transmitter to the user location (14). The terrestrial transmitter (20) is located with respect to the user location (14) so that the wireless transmission route (40) is at a relatively large angle to the centerline (28) of the first antenna (16). The angle of the wireless transmission route (40) to the satellite antenna centerline (28) is large enough so that the terrestrial signals present at the location (14) result in terrestrial input signals from the antenna (16) which are less than an interference level with respect to satellite input signals produced by the antenna. Thus, the terrestrial signals do not interfere with the satellite signals even though they are transmitted at a common frequency.

20 Claims, 3 Drawing Sheets



U.S. PATENT DOCUMENTS

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Figure 1

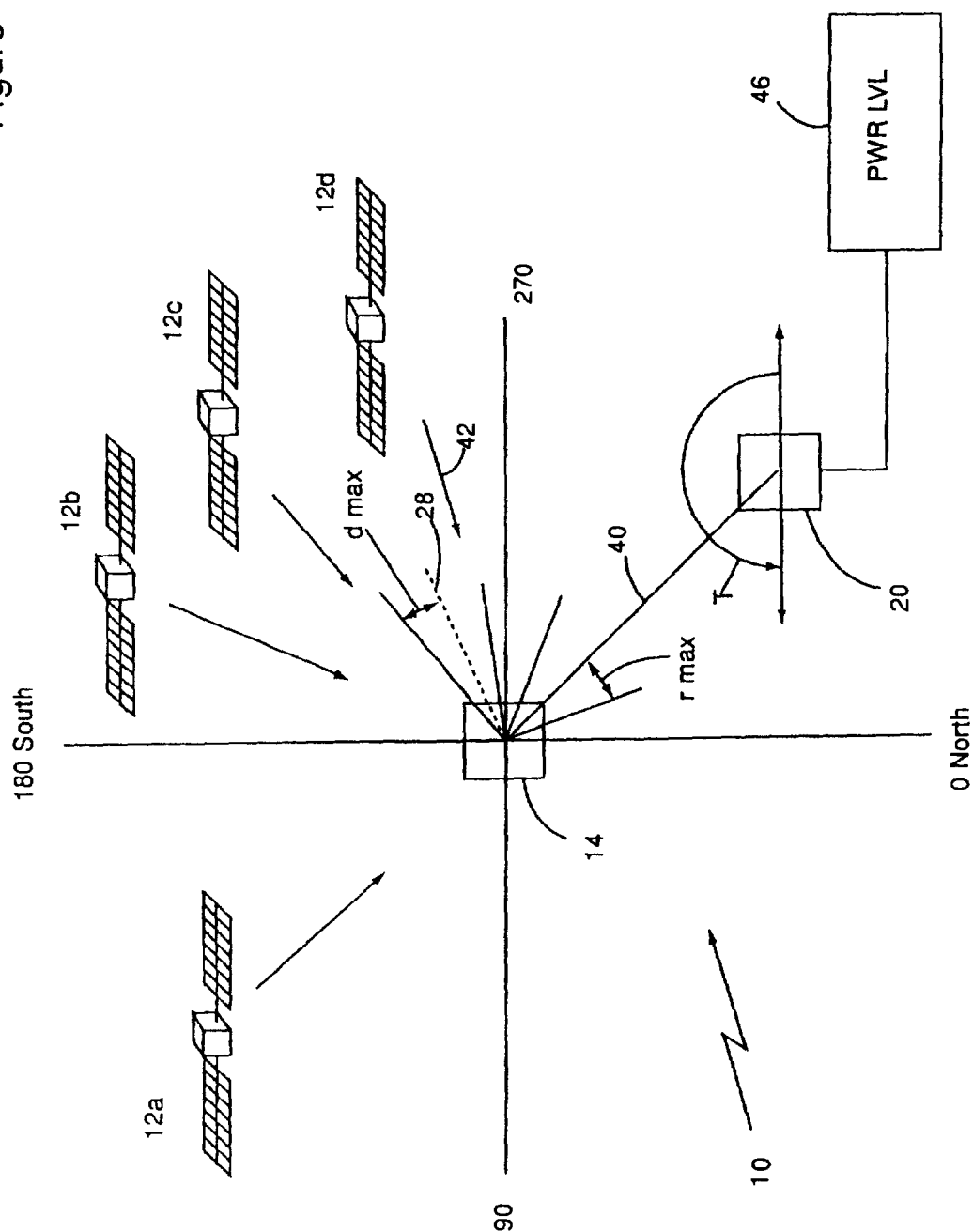


Figure 2

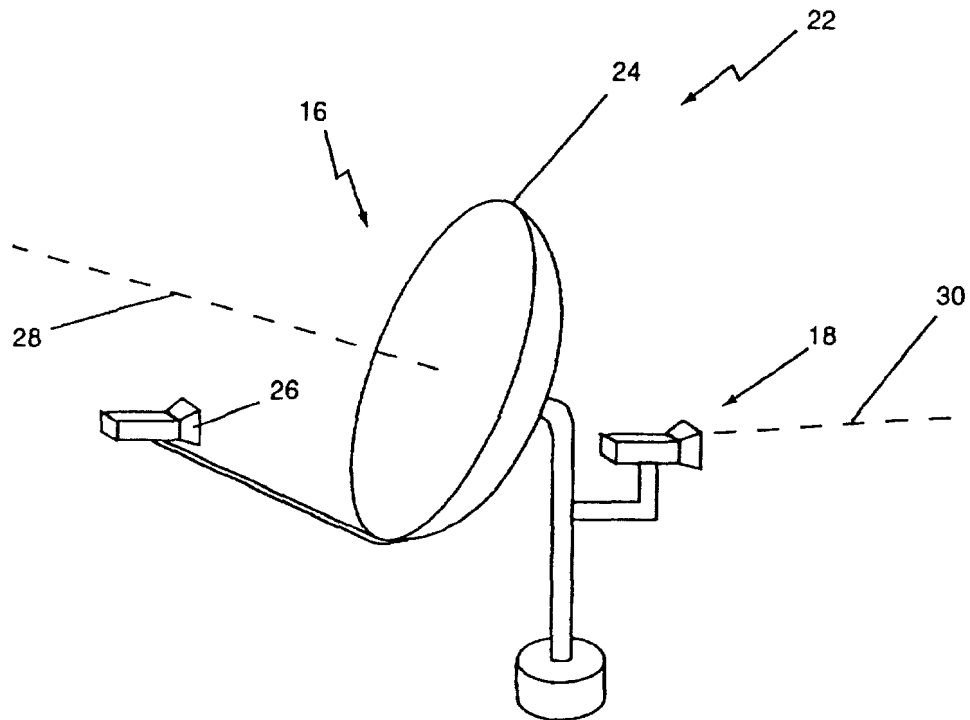


Figure 3

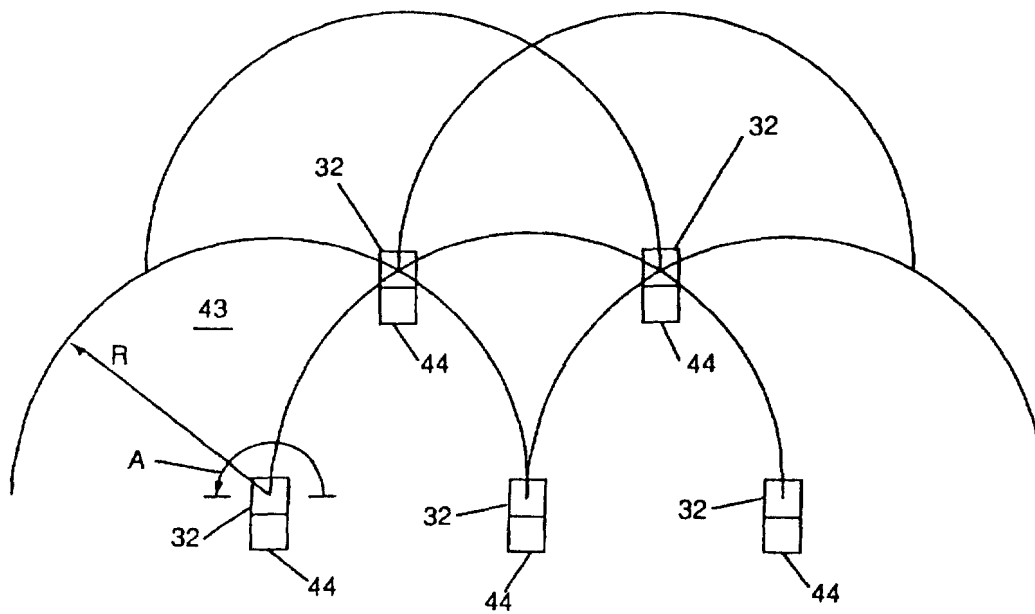
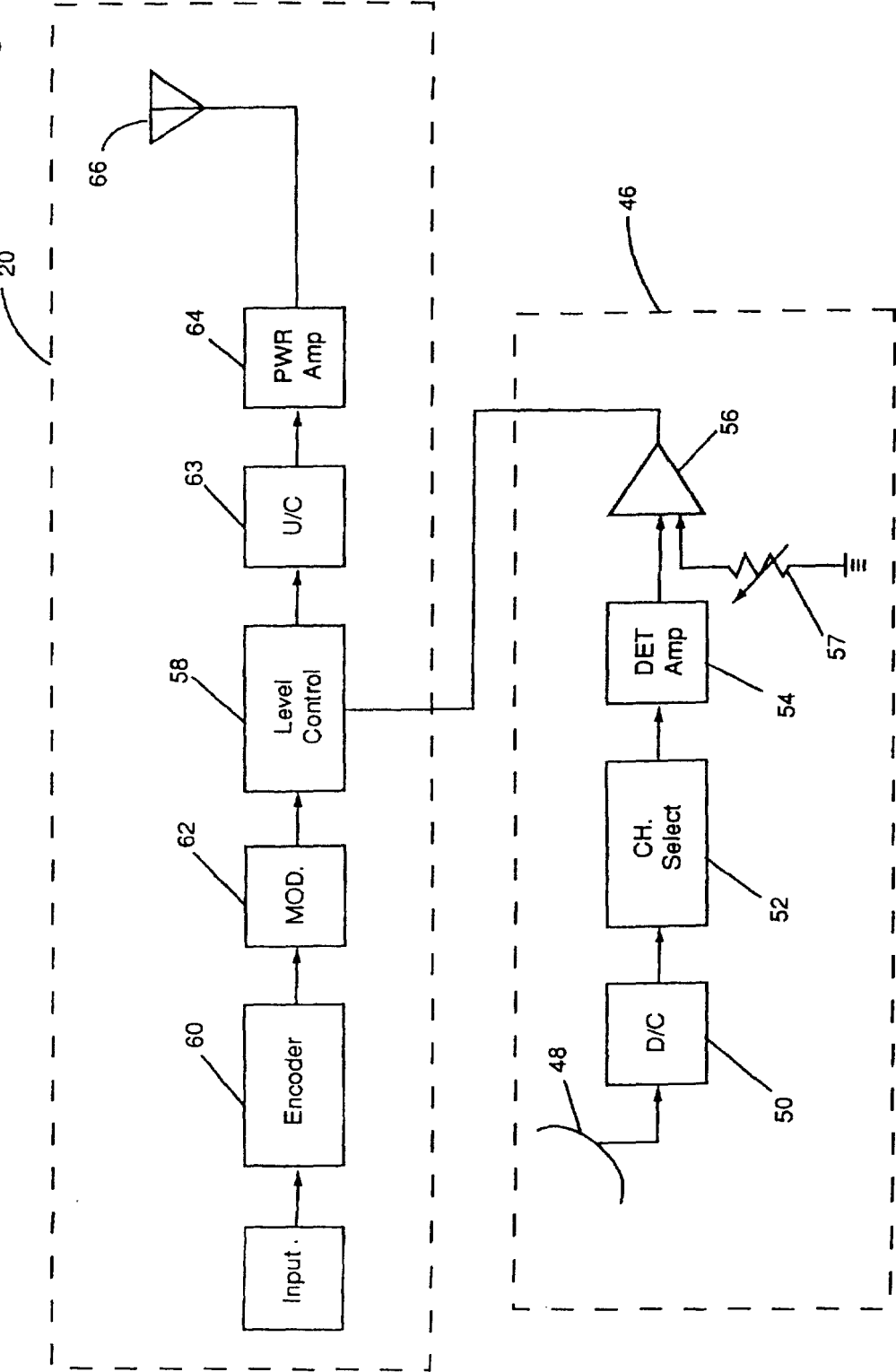


Figure 4



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APPARATUS AND METHOD FOR FACILITATING TERRESTRIAL TRANSMISSIONS AT FREQUENCIES ALSO USED FOR SATELLITE TRANSMISSIONS TO A COMMON GEOGRAPHIC AREA

This application is a continuation-in-part of application Ser. No. 08/731,244 filed Oct. 11, 1996, now U.S. Pat. No. 5,761,605.

BACKGROUND OF THE INVENTION

This invention relates to apparatus and methods for broadcasting and receiving data, including digital television signals, voice signals, and other data. More particularly, this invention relates to an apparatus and method for providing terrestrial transmissions simultaneously along with direct broadcast satellite transmissions on a common frequency and for setting the transmission power level for the terrestrial transmissions.

Currently, television signals may be received from a satellite in geosynchronous orbit about the earth. The television signals are transmitted from a terrestrial transmitter to the satellite, perhaps communicated between different satellites, and then retransmitted from a satellite so that the signals can be received by terrestrial receivers within a certain geographic receiving area within a line of sight of the satellite. In addition to television signals, other types of data may also be transmitted to consumers through satellites in either geosynchronous or non-geosynchronous orbit.

Direct broadcast satellite service (DBS) refers to satellite transmission of television signals and other data directly for use by individual households or subscribers having the proper signal receiving equipment. The U.S. Federal Communications Commission has dedicated the electromagnetic spectrum from 12.2 gigahertz to 12.7 gigahertz for DBS broadcasting. Numerous signal carriers are located within the DBS spectrum, each carrier carrying several individual television channels. Depending upon the compression technology applied to these signals, literally hundreds of separate channels may be available through DBS. A great benefit of the DBS system as opposed to prior satellite systems is that only a small dish-type antenna is required to receive the DBS signals and the alignment of the receiving dish is not as critical as earlier satellite broadcast systems. Also, the DBS system will provide high quality reception at any point in the geographic receiving area of a satellite without the expense of land transmission lines such as those required for cable television.

Current regulations require that DBS satellites be separated from each other by at least nine (9) degrees in a geosynchronous arc. The receiving antenna for DBS signals must, therefore, be limited to receiving signals in a directional range measuring plus or minus nine (9) degrees from a centerline of the antenna. Receiving signals in a range wider than the satellite spacing would cause interference by signals transmitted by different satellites on the same frequency. The limited directional reception range of the DBS receiving antenna is the result of the gain provided by the antenna being asymmetrical about the antenna structure. DBS signals reaching the DBS receiving antenna at angles outside of the directional range of the antenna receive insufficient gain to interfere with the desired DBS signals received within the antenna directional range.

U.S. Pat. No. 5,483,663 is directed to a system having a receiver arrangement in which DBS and terrestrial signals are received within similar frequency bands. The system

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shown in the 5,483,663 Patent may be implemented with a multiple antenna arrangement, or with a single, moveable antenna. In the multiple antenna arrangement, two separate antennas direct the received signals to a common propagation path for processing as if they were received by a single antenna and transmitted from a single location. In the single antenna arrangement, the antenna is movable between a position to receive DBS signals and another position to receive terrestrial signals.

The advantage of the system shown in U.S. Pat. No. 5,483,663 is that local originating signals, whether carrying data for television or other data, may be received simultaneously with DBS signals, and processed with the same or similar equipment as that used to process the DBS signals. The local originating signals may carry local television programming which may be received along with the national or regional DBS television programming.

SUMMARY OF THE INVENTION

It is an object of the invention to provide terrestrially transmitted signals simultaneously with satellite transmitted signals at the same frequency. The invention includes an apparatus and method for use in transmitting terrestrial signals simultaneously with satellite signals transmitted at a common frequency.

The object of the invention is accomplished by transmitting terrestrial signals in a manner which ensures that they do not interfere with satellite signals transmitted at the same frequency. Embodiments of the invention may take advantage of receiving antennae having a limited directional reception range or look angle and may include transmitting the terrestrial signals in a different range of directions than those in which the satellite signals are transmitted. The power level at which the terrestrial signals are transmitted and the directional nature of the satellite receiving antennae ensure that the satellite transmitted signals can be discriminated from the terrestrially transmitted signals. Although the terrestrial signal transmission power is limited to a non-interfering transmission power level, the terrestrial transmission is still strong enough to produce a usable signal at a distant location.

Several different signals will be discussed in this disclosure. The term "satellite signals" refers to signals transmitted directly from a satellite, whereas the term "terrestrial signals" refers to signals transmitted directly from a terrestrial transmitter. "Satellite input signals" refers to signals resulting from satellite signals which have been picked up by an antenna and subjected to gain provided by the antenna. Finally, "terrestrial input signals" refers to signals resulting from terrestrial signals which have been picked up by an antenna and subjected to gain provided by the antenna.

The invention is employed in the situation in which satellite signals are transmitted at a satellite transmission frequency to a terrestrial location. The satellite signals travel along a satellite signal route from the satellite to the terrestrial location and to a satellite receiving antenna at the location for receiving the satellite signals. In some embodiments of the invention, the satellite receiving antenna is omni-directional, that is, provides generally the same gain regardless of the direction from which the signals reach the antenna. In other forms of the invention, the satellite receiving antenna has a directional reception characteristic in which the gain provided by the antenna reaches a peak along an antenna centerline and generally decreases as the angle from the centerline increases.

The omni-directional satellite receiving antenna need not be oriented in a particular direction to receive signals from

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a satellite. However, in order to receive satellite signals with the directional satellite receiving antenna, the antenna must be aligned in a satellite reception position. In this satellite reception position, the satellite signal route lies close enough to the antenna centerline that the signals receive sufficient gain from the antenna structure to produce satellite input signals which are at least at a usable input signal level. This minimum usable input signal level represents the minimum input signal level at which the receiving or signal processing equipment can extract the desired data.

According to the invention, the terrestrial signals are transmitted at the same frequency as the satellite signals. The terrestrial signals are transmitted along a wireless route from the terrestrial transmitter to a user location which may have a satellite receiving antenna. The invention avoids interference between the terrestrial and satellite signals by ensuring that the power level of the terrestrial input signals at the satellite receiving antenna is below an interference level with respect to the satellite input signals at the satellite receiving antenna. The interference level is an input signal power level which is so close in power to the satellite input signal power level that the satellite input signals cannot be discriminated or distinguished. Terrestrial input signals below the interference level do not prevent the receiving or signal processing equipment associated with the satellite receiving antenna from distinguishing and extracting data from the satellite input signals. Also according to the invention, although the terrestrial signals are transmitted so that they do not interfere with the satellite signals, the terrestrial signals present at the user location must be strong enough so that they may be received by an appropriately aligned terrestrial receiving antenna at the location and distinguished from satellite input signals at the terrestrial receiving antenna. That is, the terrestrial signals present at the location must be at least at a minimum usable terrestrial signal level.

Where the satellite receiving antenna is omni-directional, both the satellite signals and the terrestrial signals picked up by the antenna receive substantially the same gain. Thus for omni-directional satellite receiving antennae, the terrestrial transmission power level must be controlled so that the terrestrial signals present at the user location have a sufficiently lower power level than the satellite signals present at the user location.

Where the satellite receiving antenna at the user location is a directional antenna, the invention may take advantage of the directional characteristic of the antenna and may transmit terrestrial signals at a high enough power level while still producing a terrestrial input signal at the satellite receiving antenna which is below the interference level. In the case of the directional satellite receiving antenna, the antenna is oriented in the satellite reception position at the user location. The terrestrial transmitter is located with respect to the user location such that the wireless transmission route from the terrestrial transmitter to the user location is at a relatively large angle from the satellite receiving antenna centerline. At this relatively large angle, the terrestrial signals receive much less gain than the satellite signals. Thus, the terrestrial signal power level at the user location may be the same as or even higher than the satellite signal level and, due to the different gain applied to the signals by the antenna structure, still result in a terrestrial input signal having a power level below the interference level with respect to the satellite input signal level.

In some applications of the invention, depending upon the direction at which a directional satellite receiving antenna must be directed to receive satellite signals, the terrestrial

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transmissions may be limited to a certain azimuth range. This terrestrial transmission azimuth range is limited so that it does not include any directions that are within the satellite reception look angle of a directional satellite receiving antenna aligned to receive signals from a particular satellite. In order to cover a large geographic service area for terrestrial signal reception while maintaining the terrestrial transmission power at a non-interfering level, a plurality of terrestrial transmitters may be spaced apart over the area. In this case the effective transmission areas of the different transmitters combine to ensure the terrestrial signals may be received clearly at each location within the desired geographic service area.

The satellite transmissions and terrestrial transmissions may contain or carry any type of data including television, internet communications, voice, video, or any other type of data. Although the invention is not limited to any particular transmission frequencies, the invention is particularly well adapted for transmission frequencies above one thousand (1000) megahertz. Also, although the invention is not limited for use with a particular transmission modulation technique, modulation techniques such as phase modulation and spectrum spreading (frequency hopping) are currently preferred.

These and other objects, advantages, and features of the invention will be apparent from the following description of the preferred embodiments, considered along with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation showing the positions of a plurality of satellites in relation to a single terrestrial transmitter and a receiver or user location.

FIG. 2 is a somewhat schematic representation of a receiving antenna structure for receiving satellite and terrestrial transmitted signals at a common frequency.

FIG. 3 is a schematic representation of the spacing for a number of terrestrial transmitters required to allow reception over a large geographic area.

FIG. 4 is a schematic representation of a terrestrial transmitter and terrestrial transmission power control arrangement embodying the principles of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An apparatus according to the invention for providing terrestrially transmitted signals simultaneously on the same frequency used to transmit satellite signals is illustrated in FIG. 1. As shown in FIG. 1, there may be one or more satellites in orbit about the earth. FIG. 1 shows four satellites 12a, 12b, 12c, and 12d spaced apart at four separate directions from a user location 14. Satellite receiving antenna 16 and terrestrial receiving antenna 18, which will be discussed in detail with reference to FIG. 2, may be located at the user location 14.

Each of these satellites 12a-d is positioned in geosynchronous orbit about the center of the earth, and is positioned at a certain longitude and latitude above the earth's surface. In geosynchronous orbit, each satellite remains at a fixed location with respect to the earth's surface, and thus, with respect to the user location 14. As is known by those skilled in the art, a directional receiving antenna may be directed at a certain elevation and direction or azimuth toward a desired satellite location for receiving signals from the particular satellite. Of course the satellite signals may be

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transmitted from satellites which are not in geosynchronous orbit. In this non-geosynchronous orbit case, the directional satellite receiving antenna can receive satellite signals only as the particular satellite passes through the directional reception range or look angle of the satellite receiving antenna, or the antenna must be moved to track the satellite.

Currently, all direct broadcast satellites within the line of sight of North America are positioned at longitudes and latitudes requiring a directional receiving antenna to face in a southerly direction from North America to receive signals. Although FIG. 1 shows four satellites 12a-d for purposes of describing the invention, more or fewer satellites may be spaced apart within a line of sight of a certain geographical area. Regardless of the number of satellites, the directional satellite receiving antenna must be directed at a particular azimuth and elevation to receive signals from a particular satellite. The term "azimuth" refers to the direction with respect to a reference direction such as due north, commonly zero degrees. "Elevation" refers to the angle of the antenna centerline above horizontal. In contrast to directional receiving antennae, omni-directional antennae need not be oriented in any particular direction in order to receive signals. Thus an omni-directional antenna at the user location 14 would receive signals equally well from each of the satellites 12a-d.

DBS satellites all transmit different signals in the same frequency band. The U.S. Federal Communications Commission has set aside the electromagnetic spectrum from 12.2 gigahertz to 12.7 gigahertz for DBS broadcasting. In order to ensure no interference from signals between two adjacent satellites transmitting at the same frequency, two conditions must be met. First, the satellite receiving antenna must be a directional antenna and limited to receive signals at the DBS signal strength only within a certain reception range about the centerline of the antenna. Secondly, the satellites must be spaced apart so that a receiving antenna may be positioned with only a single satellite transmitting in the directional reception range or look angle of the antenna.

According to current regulations, individual DBS satellites must be separated at least nine (9) degrees in the geosynchronous arc. Thus, each DBS receiving antenna must have a directional reception range, look angle, or aperture of plus or minus nine (9) degrees or less as measured from a centerline of the antenna. Although current regulations require a spacing of no less than nine (9) degrees separation, the invention is not limited to use in situations in which the satellites have this degree of separation or in which the satellites operate in the current DBS frequencies.

FIG. 1 also shows a terrestrial transmitter 20 capable of transmitting in one or more frequencies identical to a frequency transmitted by one of the DBS satellites. The terrestrial transmitter 20 transmits directionally within a certain transmission range or azimuth range T. The transmission range T shown in FIG. 1 is 180 degrees, although the range may be more or less than this number. In some situations, the transmission range may not be limited but may encompass the entire 360 degrees around the transmitter location.

A combined receiving antenna structure 22 which may be at the user location 14 in FIG. 1 is illustrated in FIG. 2. The satellite receiving antenna 16 is designed to receive direct broadcast satellite signals and preferably includes a collecting dish 24 and a feed-horn assembly 26 for receiving the signals reflected and concentrated by the dish. Those skilled in the art will readily appreciate that the feed-horn assembly 26 includes a probe and low noise block converter, which are

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not shown in FIG. 2, for picking up signals directed to the antenna. The received signals, which are defined herein as "input signals," are directed from the antenna to receiving or signal processing equipment, also not shown, for extracting information or data. This signal processing equipment is well known in the art and does not form a part of this invention. Also, those skilled in the art will appreciate that numerous types of assemblies may be used alternatively to the feed-horn assembly 26 for collecting signals reflected by the dish 24. Furthermore, many other types of antennae may be used for receiving the satellite signals.

The satellite receiving antenna 16 is a directional antenna and thus has the characteristic that the signal gain produced by the antenna is highly dependent upon the direction at which the signals reach the antenna. The antenna 16 produces a maximum gain for signals travelling to the structure along an antenna centerline 28. For signals travelling to the antenna structure 16 at an angle to the centerline 28, the antenna provides less gain. For the dish-type antenna 16 shown in FIG. 2, the antenna gain decreases as the angle to the centerline 28 increases up to a certain angle on either side of the centerline. At angles outside of this certain angle, the gain may remain fairly constant. It will be understood that the angle from the centerline 28 may be in the horizontal direction, vertical direction, or both.

As the antenna gain decreases with the increased angle from the centerline 28, an angle is reached at which the antenna gain is insufficient to develop a usable satellite input signal from the antenna 16 for a particular satellite transmission. The maximum reception angle at which the antenna 16 will develop a usable signal is shown as d_{max} in FIG. 1. The cone-shaped area defined by the angle d_{max} about the centerline 28 is commonly referred to as the "look angle" or aperture of the antenna. Satellite signals at the designated power level propagating to the antenna 16 at an angle greater than d_{max} to the antenna centerline 28 result in input signals from the antenna less than the minimum usable input signal level. Signals below the minimum usable input signal level cannot be distinguished from background or noise produced by the antenna, and the signal processing equipment which receives the input signals cannot extract data from signals at these low signal levels. The minimum usable input signal level is determined by many factors including the bandwidth of the transmissions, the antenna structure, and the signal processing equipment which receives the signals developed by the antenna structure.

Referring to FIGS. 1 and 2, the satellite receiving antenna 16 which may be at location 14 is in a satellite reception position and is directed to receive signals from one of the satellites, satellite 12d for example. The azimuth and elevation at which the first antenna 16 must be directed for optimally receiving signals from satellite 12d may be, for example, 247.3 degrees and 25.7 degrees, respectively.

In the orientation shown in FIG. 1, the satellite receiving antenna 16 at location 14 cannot receive signals from the terrestrial transmitter 20 in the presence of satellite signals at the same frequency. Two factors combine to prevent interference between the satellite and terrestrial signals. First, signals transmitted from the terrestrial transmitter 20 travel along a wireless transmission route 40 to the location 14 which lies outside of the look angle of the satellite receiving antenna 16. Thus, the terrestrial signals receive relatively low gain from the satellite receiving antenna 16 as compared to the satellite signals travelling along a satellite signal route 42 within the look angle of the antenna. Second, the terrestrial transmission power level is controlled according to the invention such that terrestrial signals at the

location 14, with the low gain provided by the antenna 16 for signals travelling along wireless transmission route 40, result in terrestrial input signals from the antenna 16 which are below the interference level with respect to the satellite input signals from the antenna. Thus, even though the terrestrial signals may actually be picked up by the antenna 16 and produce terrestrial input signals from the antenna, the satellite input signals are in comparison strong enough for the signal processing equipment associated with the antenna to discriminate between the satellite and terrestrial input signals. The interference level will depend on several factors including primarily the signal processing equipment and, with present technology, may be in the range of 3 dB to 5 dB below the level of the satellite input signals.

Although the direction of the terrestrial transmissions along wireless route 40 and terrestrial signal power level combine to prevent the terrestrial signals from interfering with the satellite signals at the same frequency, the power level of the terrestrial transmissions is still sufficient to produce a usable signal at the location 14. In order to receive terrestrial signals at the location, a terrestrial receiving antenna such as the antenna 18 shown in FIG. 2 is required. The terrestrial receiving antenna 18 has a directional gain characteristic similar to the satellite receiving antenna 16 to ensure that the terrestrial signals produce an input which may be discriminated from the input produced by the satellite signals at the terrestrial antenna. For example, the terrestrial receiving antenna 18 at location 14 could have its centerline 30 aligned directly with the wireless transmission route 40 from the terrestrial transmitter 20. The directional reception range or look angle from the centerline of the antenna 18 is shown as α max in FIG. 1. At this orientation, the satellite signals are well outside the look angle of the terrestrial receiving antenna 18 and receive much lower gain as compared to the terrestrial signals. The terrestrial signals at that location 14 are strong enough that, with the help of the gain provided by the terrestrial receiving antenna 18, they result in terrestrial input signals that may be discriminated from any input signals at the terrestrial receiving antenna resulting from the satellite signals. With present technology the terrestrial input signals from the terrestrial receiving antenna 18 may be 3 dB to 5 dB or more above the power level of the satellite input signals from the terrestrial receiving antenna in order for the terrestrial input signals to be discriminated. Thus, the terrestrial transmission apparatus and method according to the invention allows satellite and terrestrial signals carrying entirely different information or data to be received and used simultaneously at user location 14.

The ability to transmit terrestrial signals at the same frequency as satellite signals without interference between the signals presents an opportunity for terrestrial reuse of spectrum previously reserved exclusively for satellite transmissions. Furthermore, since the terrestrial transmitter according to the invention has a limited effective transmission range, the spectrum reused for the terrestrial transmissions may also be reused for terrestrial transmissions in many different geographic areas.

It will be understood that the terrestrial receiving antenna 18 at the location 14 or any other user location, is not an element of the present invention. The terrestrial receiving antenna 18 is disclosed and discussed herein only for the purpose of emphasizing the utility of the terrestrial transmitting apparatus and method according to the invention. The satellite receiving antenna 16 is also not an element of the invention. Rather, the satellite receiving antenna 16 is discussed herein for the purpose of describing the manner

and direction in which terrestrial signals must be transmitted according to the invention. In any case, the satellite and terrestrial receiving antennae which may be at any user location 14 need not be combined into a single structure. The combined structure 22 shown in FIG. 2 is shown for convenience in describing the terrestrial transmission invention disclosed herein.

In the case of an omni-directional satellite receiving antenna, the antenna has no centerline such as centerline 28 shown in FIGS. 1 and 2, and no look angle or directional reception range. Rather, the gain provided by the antenna is substantially independent of the direction from which the signals reach the antenna. In that case, the method of the invention includes transmitting terrestrial signals at the first frequency similarly to the case described above in which the satellite receiving antenna is a directional antenna. However, the direction at which the terrestrial signals are transmitted cannot be relied upon to produce terrestrial input signals below the interference level with respect to the satellite input signals received at the omni-directional satellite receiving antenna. Rather, for the omni-directional satellite receiving antenna, the terrestrial transmission power level is controlled so that the terrestrial signals present at the user location are below the interference level with respect to the satellite signals at the user location. Since the omni-directional antenna provides the same gain to both the terrestrial and satellite signals, this signal level present at the satellite receiving antenna location ensures that the terrestrial input signals are below the interference level with respect to the satellite input signals.

Referring to FIG. 3, a plurality of terrestrial transmitters 32 may be required to provide terrestrial signals strong enough to be received over a large area, but low enough to prevent interference with satellite signals at the same frequency. Each transmitter 32 in FIG. 3 transmits directionally in an azimuth range A of approximately 180 degrees and out to an effective reception range R. Thus, each transmitter 32 transmits to an effective transmission area 43. With this transmitter spacing and transmission range, the signals from the terrestrial transmitters 32 may be received from any location within the geographic service area comprising the combined effective transmission areas of the several terrestrial transmitters. Although the directional range of 180 degrees is shown for purposes of example, the terrestrial transmissions may be in other ranges within the scope of this invention. In each case, however, the terrestrial transmissions from each transmitter 32 are in directions that are outside of the satellite receiving antenna look angle at any location and, with the terrestrial signal power limitation according to the invention, the terrestrial signals do not interfere with the satellite signals transmitted at the same frequency.

In another aspect of the invention, the user location itself may include a transmitter for directionally transmitting at a satellite frequency. Such transmission capability from the user location would allow wireless communication both to and from the user location. The transmissions from the user location would be limited so as to include no direction within the look angle of a nearby satellite receiving antenna and would be limited as to transmission power as discussed above with regard to other terrestrial transmissions.

In the multiple terrestrial transmitter application of the invention such as the arrangement depicted in FIG. 3, it may be desirable, although not necessary, for the signals from the several transmitters 32 to be synchronized. The synchronization in this sense means that each transmitter transmits the same data at the same frequency so that it may be received

substantially simultaneously at a user location which lies within the effective transmission area (the area defined by radius R) of two or more different transmitters. Thus, regardless of which transmitter 32 a user may direct their terrestrial receiving antenna to, the user receives the very same data as any other user of terrestrial signals at that frequency in the geographic service area. The transmitters may have associated with them signal synchronization means 44 for enabling this synchronized transmission. Those skilled in the art will appreciate that several different arrangements may be used to provide such synchronization. For example, the signal synchronization means 44 may comprise high speed communications links such as optical fiber or high speed electrical communications links for communicating data to be transmitted or synchronization signals between transmitters 32. Alternatively the synchronization means 44 may comprise high gain antennae for relaying the received signals from one transmitter 32 to the next. Any such relaying antennae and high speed communication links are to be considered equivalent signal synchronization means according to the invention.

As discussed above, and referring again to FIG. 1, the power level at which the terrestrial signals may be transmitted must be limited to prevent interference with the satellite signals transmitted at the same frequency. However, the transmission power must still be strong enough to produce a usable signal level at a distant location, location 14 for example. The power level of the terrestrially transmitted signals is highest near the transmitter and decreases as the distance from the transmitter increases. Thus, the transmission power is limited by the maximum terrestrial signal level at the potential satellite signal user location which is nearest to the terrestrial transmitter 20. The maximum terrestrial signal level at the nearest satellite user location to the terrestrial transmitter is a signal which produces a terrestrial input signal at a satellite receiving antenna at that nearest location which is just below the interference level with respect to the satellite input signals which may be received by the satellite receiving antenna at that location. The transmission power to produce signals of this strength at the nearest location to the terrestrial transmitter 20 represents the maximum allowable transmission power and determines the effective transmission range or area of the terrestrial transmitter. This maximum level and all transmission power levels below this maximum level are non-interfering power levels and produce non-interfering terrestrial input signals at any satellite receiving antenna in the effective transmission area of the terrestrial transmitter 20.

A certain area around the terrestrial transmitter may be designated an exclusion zone and the nearest location to the terrestrial transmitter may be defined as a location at the edge of the exclusion zone. In this case, the transmission power of the terrestrial transmitter is controlled so that the terrestrial signals are just below the interference power level at this "nearest location" at the edge of the exclusion zone. The terrestrial signal level at locations within the exclusion zone is at a level which could cause interference with satellite signals unless the satellite receiving antenna design is modified to increase the directionality of the antenna, that is, the difference between the gain provided to the satellite signals and the gain provided to the terrestrial signals.

It will be apparent that the maximum power level at which terrestrial signals may be transmitted in accordance with the invention is dependent in part upon the power level of the satellite signals at the various user locations. As shown in FIGS. 1 and 4, one preferred form of the invention includes

a satellite signal power level monitoring arrangement or means 46 for determining the power level of the satellite signals and for using that power level to set the power level of the terrestrial transmitter 20. Referring now to FIG. 4, the satellite signal power level monitoring means 46 may comprise a calibrated receiver or any other suitable device by which the satellite signal strength may be determined. The illustrated calibrated receiver includes a satellite receiving antenna 48, a down-converter 50, preferably a channel selector 52, and a detector amplifier 54. The illustrated calibrated receiver also includes a comparator 56 with a variable resistance device 57 connected to one comparator input. The other comparator input is connected to receive the signal from the detector amplifier 54. Comparator 56 has its output connected transmission power adjusting means comprising to a level control device 58 associated with the terrestrial transmitter 20.

The illustrated transmitter 20 includes an encoder 60, which receives and encodes an input for terrestrial transmission, and also includes a modulator 62 for providing the desired modulation for transmission. The level control device 58 is interposed between the modulator 62 and an up-converter 63 which converts the signals to the desired higher frequency for transmission. The converted signals are then amplified by the power amplifier 64 and directed to a transmitter antenna 66.

The satellite power level monitoring arrangement 46 operates by continuously monitoring a satellite signal which, due to the particular satellite orientation and/or transmission power, is most susceptible to interference from the terrestrial transmitted signals. The satellite receiving antenna 48 is directed to receive the signal from that most susceptible satellite, and the received signal is down converted to an intermediate frequency by the down converter 50.

The down converted signal may be processed by the channel selector 52 to separate a single channel and this separated signal is then filtered and converted to a dc voltage signal by the detector amplifier 54. This dc voltage signal is representative of the power level of the received satellite signal, and is compared to a reference signal by the comparator 56. The reference signal is set by the variable resistance 57 initially so that the comparator output is zero. At this initial setting, the transmission power level of transmitter 20 is set at a maximum non-interfering power level. At this power level the terrestrial signals at the various locations beyond any exclusion zone around the transmitter 20 result in terrestrial input signals which are below the interfering power level with respect to any satellite input signals at the same frequency. However, as the signal power of the satellite signals received at the antenna 48 changes over time, the output of comparator 56 causes the level control 58 to change the transmission power of the terrestrial transmitter 20 accordingly. When the satellite signal becomes weaker than at initial conditions, the comparator 56 output is less than zero and this causes the level control 58 to reduce the transmission power from transmitter 20. When the satellite signal becomes stronger, the comparator 56 output returns toward zero and this causes the level control 58 to increase the transmission power to transmitter antenna 66.

The method of the invention may now be described with particular reference to FIGS. 1 and 2. A first frequency is already in use for transmitting satellite signals from a satellite, satellite 12d for example, along the satellite signal 42 route to location 14. Satellite signals are received at the location 14 with the satellite receiving antenna 16 shown in FIG. 2. Satellite receiving antenna 16 has a directional

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reception characteristic with a maximum gain along the antenna centerline 28 and lower gain at angles from the antenna centerline. The satellite receiving antenna 16 is oriented in a satellite reception position in which the satellite signal route 42 is within a look angle d_{max} on either side of, or about, the centerline 28 of the antenna. In this satellite reception position, the satellite signals produce a satellite input signal from the satellite receiving antenna 16 and this input signal is at least at the minimum usable signal level for the particular signal processing equipment.

The method of the invention includes transmitting terrestrial signals at the first frequency, that is, the same frequency at which the satellite signals are transmitted. The terrestrial signals are transmitted in directions which include the wireless transmission route 40 from the transmitter 20 to the location 14. According to the invention, the transmitter 20 is located such that the wireless transmission route 40 lies at an angle to the satellite receiving antenna centerline 28, and this angle is sufficiently large that the terrestrial signals present at the location 14 produce terrestrial input signals which are below the interference level with respect to the satellite input signals produced at the antenna 16. The terrestrial signals present at the location 14 are also at a power level at least at the minimum usable terrestrial signal level. At this minimum useable terrestrial signal level the terrestrial signals may be picked up by a terrestrial antenna 18 which may be at the user location 14. The terrestrial antenna 18 is a directional antenna to ensure that the satellite signals do not interfere with the terrestrial signals.

Under current technology, the satellite signal level at any terrestrial user location may range from -120dBm to -125 dBm under clear sky conditions and from -122 dBm to -127 dBm under more adverse weather conditions. Depending primarily upon the directionality of the satellite receiving antenna and the capabilities of the signal processing equipment associated with the satellite receiving antenna, terrestrial signal power level at the user location must remain below about -95 dBm. This terrestrial signal power level assumes a satellite receiving antenna gain of approximately 34 dB for the satellite signals and a gain of about -2 dB for the terrestrial signals, and an interference level of approximately 4 dB below the satellite input signal power level. Also, under current technology, the terrestrial input signals must remain about 4.5 dB (3 dB to 5 dB) below the satellite input signals in order for the signal processing equipment to distinguish the satellite input signals and extract the desired data from the satellite input signals. Those skilled in the art will readily appreciate that the invention is not limited to these signal power values and that these values are provided for purposes of illustration and example.

Also according to the invention, the terrestrial transmitter 20 transmits only along wireless transmission paths which avoid interference with the satellite signals at any location within an effective transmission range of the terrestrial transmitter. That is, the wireless route 40 from the transmitter 20 to any location 14 is at an angle with respect to a properly aligned satellite receiving antenna at the respective location such that the terrestrial input signals from the satellite receiving antenna are always below the interference level with respect to the satellite input signals which may be produced from the satellite receiving antenna. To ensure the required terrestrial signal strength at any location, including those adjacent to the terrestrial transmission location, the method of the invention may also include monitoring the signal strength of the satellite signals and setting the terrestrial transmission power to the maximum non-interfering power level based upon that detected satellite signal strength.

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Referring to FIG. 3, the method also includes transmitting from a second terrestrial transmitter 32 to a second location which may be any location within range R from the second terrestrial transmitter. The wireless route from the second transmitter to the second location is at an angle to a properly oriented satellite receiving antenna at the second location to produce terrestrial input signals below the interference level with respect to the satellite input signals which result from satellite signals received by the satellite receiving antenna at the second location.

EXAMPLE

A test was conducted using a mobile test antenna. The test equipment included a DBS receiving antenna connected to signal processing equipment. The signal processing equipment was connected to receive input signals from the DBS receiving antenna and operated to direct a desired channel output to a television. The DBS receiving antenna was a directional antenna providing a gain of between 31 dB and 34 dB across a look angle of approximately 5 degrees on either side of the antenna centerline. Antenna gain from the DBS receiving antenna ranged from -2 dB to -16 dB outside of the antenna look angle.

The test used a terrestrial transmitter having a directional transmitter antenna elevated to 52 feet AGL and directed with its peak power output at an azimuth of 180 degrees (due South), with true horizontal polarity. The terrestrial transmitter set up was not changed from this configuration throughout the test. Only the transmission power was varied as will be discussed below.

The interference test was conducted at several different test locations or user locations, each spaced apart from the terrestrial transmitter location. At each test location the DBS receiving antenna was first elevated to achieve a line of sight to the terrestrial transmitter and then oriented with its centerline aligned generally with the wireless transmission route from the terrestrial transmitter. Once a line of sight was verified between the DBS test antenna and the terrestrial transmitter, an isotropic receive power level was established from the terrestrial transmitter at full power, 29 dBm.

At each test location the DBS receiving antenna was then optimally positioned for receiving satellite signals from a particular DBS satellite, that is, the centerline of the DBS receiving antenna was aligned with the signal route from the satellite. The satellite signals at a particular frequency were received and fed to the television associated with the test apparatus. At each test site, the wireless transmission route from the terrestrial transmitter to the test site was outside of the look angle of the DBS receiving antenna optimally positioned for receiving satellite signals from the DBS satellite. The terrestrial transmitter was operated to transmit at the same frequency as the received satellite signals, 12.470 gigahertz. In each test if there was interference with the received DBS satellite signals, as indicated by imperfect television reception, the terrestrial transmitter power was reduced until no interference was produced and this level, that is, the power level just below the interference level, was recorded.

At the weather conditions at which the tests were conducted, the satellite signal power level at each test site is calculated to be approximately -125 dBm. Under these conditions a terrestrial transmission power level of 13 dBm produced an exclusion zone in the transmission directions around the terrestrial transmitter of approximately one quarter mile while producing useable terrestrial signals at a location approximately 9.9 miles away from the terrestrial

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transmitting antenna. It is estimated that the terrestrial signal power level at this test site was approximately -137 dBm.

The above described preferred embodiments are intended to illustrate the principles of the invention, but not to limit the scope of the invention. Various other embodiments and modifications to these preferred embodiments may be made by those skilled in the art without departing from the scope of the following claims.

What is claimed is:

1. A method for reusing a first transmission frequency already in use for transmitting satellite signals from a satellite along a satellite signal route to a first location for reception at a satellite receiving antenna which may be at the first location, the satellite receiving antenna producing a maximum gain for signals received along a satellite receiving antenna centerline and less gain at angles from said centerline, the satellite signals having a signal power level at the first location such that, when the satellite receiving antenna is placed in a satellite reception position in which the satellite transmission route lies within a satellite reception look angle about the satellite receiving antenna centerline, the satellite signals produce satellite input signals from the satellite receiving antenna which are at least at a minimum usable satellite input signal level, the method comprising the steps of:

- (a) substantially continuously detecting the satellite signal power level at a location near a first terrestrial transmitter;
- (b) setting the transmission power of the first terrestrial transmitter to a non-interfering level based upon the satellite signal power level detected near the first terrestrial transmitter, the non-interfering level being a level ensuring that substantially each location within an effective transmission area around the first terrestrial transmitter receives terrestrial signals from the first terrestrial transmitter at a power level to produce non-interfering terrestrial input signals from a satellite receiving antenna aligned to receive satellite signals at said location, the non-interfering terrestrial input signals being at a power level less than an interference level with respect to the satellite input signals produced by the satellite receiving antenna at said location; and
- (c) transmitting terrestrial signals at the first transmission frequency from the first terrestrial transmitter, the terrestrial signals being transmitted in directions including a wireless transmission route from the first terrestrial transmitter to the first location, and the wireless transmission route lying at an angle from the satellite receiving antenna centerline, when the satellite receiving antenna is in the satellite reception position, such that the terrestrial signals present at the first location result in terrestrial input signals from the satellite receiving antenna which are at a power level less than the interference power level with respect to the satellite input signals, the terrestrial signals present at the first location having a power level at least at a minimum usable terrestrial signal level.

2. The method of claim 1 wherein the step of detecting the satellite signal power level includes the steps of:

- (a) receiving the signals transmitted from the satellite at the first transmission frequency; and
- (b) converting the signals transmitted from the satellite at the first transmission frequency to a representative signal which is representative of the satellite signal power level.

3. The method of claim 2 wherein the step of setting the transmission power level for the first terrestrial transmitter includes the step of:

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- (a) comparing the representative signal to a reference signal to produce a comparison output.

4. The method of claim 3 further including the step of:

- (a) using the comparison output to control the transmission power level for the first terrestrial transmitter.

5. The method of claim 4 wherein the step of using the comparison output to control the transmission power level for the first terrestrial transmitter includes the step of:

- (a) controlling a modulated signal level in the first terrestrial transmitter.

6. An apparatus for simultaneously providing terrestrially transmitted signals on a common frequency with satellite signals transmitted from a satellite along a satellite signal route to a first location, the satellite signals being transmitted at a first frequency for reception at a satellite receiving antenna which may be at the first location, the satellite receiving antenna producing a maximum gain for signals received along a satellite receiving antenna centerline and less gain at angles to said centerline, the satellite signals having a signal power level such that, when the satellite receiving antenna is placed in a satellite reception position in which the satellite transmission route lies within a satellite reception look angle about the satellite receiving antenna centerline, the satellite signals result in satellite input signals from the satellite receiving antenna which are at least at a minimum usable satellite input signal level, the apparatus comprising:

- (a) a first terrestrial transmitter for transmitting signals at the first frequency along a wireless transmission route from a first terrestrial transmitter location to the first location, the wireless transmission route lying at an angle from the satellite receiving antenna centerline, when the satellite receiving antenna is in the satellite reception position, such that the terrestrial signals present at the first location result in terrestrial input signals from the satellite receiving antenna which are at a power level less than an interference level with respect to the satellite input signals, the terrestrial signals present at the first location having a power level at least at a minimum usable terrestrial signal level;

- (b) satellite signal power monitoring means for substantially continuously detecting the satellite signal power level at a location near the first terrestrial transmitter; and

- (c) transmission power adjusting means associated with the first terrestrial transmitter for setting the transmission power of the first terrestrial transmitter to a non-interfering level based upon the satellite signal power level detected by the satellite signal power monitoring means, the non-interfering level being a level ensuring that substantially each location within an effective transmission area around the first terrestrial transmitter receives terrestrial signals from the first terrestrial transmitter at a power level to produce non-interfering terrestrial input signals from a satellite receiving antenna aligned to receive satellite signals at said location, the non-interfering terrestrial input signals being at a power level less than the interference level with respect to the satellite input signals produced by the satellite receiving antenna at said location.

7. The apparatus of claim 6 wherein the satellite signal power monitoring means includes:

- (a) a satellite signal receiving antenna aligned to receive signals transmitted from the satellite at the first transmission frequency; and
- (b) a detector amplifier operatively connected to convert the signals received by the satellite signal receiving

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antenna to a representative signal which is representative of the satellite signal power level.

8. The apparatus of claim 7 wherein the satellite signal power monitoring means further includes:

- (a) a comparator operatively connected to compare the representative signal to a reference signal to produce a comparison output.

9. The apparatus of claim 8 wherein the transmission power adjusting means includes a level control device operatively connected to the first terrestrial transmitter and wherein the comparator is connected to apply the comparison output to the level control device.

10. The apparatus of claim 9 wherein the level control device is operatively connected to an output of a modulator associated with the first terrestrial transmitter, the level control device for controlling a modulated signal level in the first terrestrial transmitter.

11. An apparatus for simultaneously providing terrestrially transmitted signals on a common frequency with satellite signals transmitted from a satellite, the satellite signals being transmitted at a first frequency along a satellite transmission route to a satellite receiving antenna at a location which may be anywhere within a geographic service area, the satellite receiving antenna producing a maximum gain for signals received along a satellite receiving antenna centerline and less gain at angles from said centerline, the satellite signals having a signal power level which, when the satellite receiving antenna is placed at a satellite reception position in which the satellite transmission route lies within a satellite reception look angle about the satellite receiving antenna centerline, results in satellite input signals from the satellite receiving antenna, the satellite input signals being at least at a minimum usable satellite input signal level, the apparatus comprising:

- (a) a plurality of spaced apart terrestrial transmitters, each terrestrial transmitter transmitting terrestrial signals at the first frequency, the plurality of spaced apart terrestrial transmitters being arranged such that substantially each respective location within the geographic service area has a wireless transmission route to one of the terrestrial transmitters, the wireless transmission route lying at an angle from the satellite receiving antenna centerline when the satellite receiving antenna is in the satellite reception position at the respective location such that the terrestrial signals present at the respective location are at least at a minimum usable terrestrial signal level but result in terrestrial input signals from the satellite receiving antenna which are at a power level less than an interference level with respect to the satellite input signals;

- (b) satellite signal power monitoring means for substantially continuously detecting the satellite signal power level at a monitoring location within the geographic service area; and

- (c) transmission power adjusting means associated with the terrestrial transmitters for setting the transmission power of the terrestrial transmitters to a non-interfering level based upon the satellite signal power level detected by the satellite signal power monitoring means, the non-interfering level being a level ensuring that substantially each location within the geographic service area receives terrestrial signals from each of the terrestrial transmitters at a power level to result in non-interfering terrestrial input signals from a satellite receiving antenna aligned to receive satellite signals at said location, the noninterfering terrestrial input signals being at a power level less than the interference level

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with respect to the satellite input signals produced by the satellite receiving antenna at said location.

12. The apparatus of claim 11 wherein the satellite signal power monitoring means includes:

- (a) a satellite signal receiving antenna aligned to receive signals transmitted from the satellite at the first transmission frequency; and
- (b) a detector amplifier operatively connected to convert the signals received by the satellite signal receiving antenna to a representative signal which is representative of the satellite signal power level.

13. The apparatus of claim 12 wherein the satellite signal power monitoring means further includes:

- (a) a comparator operatively connected to compare the representative signal to a reference signal to produce a comparison output.

14. The apparatus of claim 13 wherein the transmission power adjusting means includes a level control device operatively connected to the first terrestrial transmitter and wherein the comparator is connected to apply the comparison output to the level control device.

15. The apparatus of claim 14 wherein the level control device is operatively connected to an output of a modulator associated with the first terrestrial transmitter, the level control device for controlling a modulated signal level in the first terrestrial transmitter.

16. A method for reusing a first transmission frequency already in use for transmitting satellite signals from a satellite along a satellite signal route to a first location for reception at a satellite receiving antenna which may be at the first location, the satellite receiving antenna producing a maximum gain for signals received along a satellite receiving antenna centerline and less gain at angles from said centerline, the satellite signals having a signal power level at the first location such that, when the satellite receiving antenna is placed in a satellite reception position in which the satellite transmission route lies within a satellite reception look angle about the satellite receiving antenna centerline, the satellite signals produce satellite input signals from the satellite receiving antenna which are at least at a minimum usable satellite input signal level, the method comprising the steps of:

- (a) determining the satellite signal power level;
- (b) setting the transmission power of a first terrestrial transmitter to a non-interfering level based upon the determined satellite signal power level, the non-interfering level being a level ensuring that substantially each location within an effective transmission area around the first terrestrial transmitter receives terrestrial signals from the first terrestrial transmitter at a power level to produce non-interfering terrestrial input signals from a satellite receiving antenna aligned to receive the satellite signals at said location, the non-interfering terrestrial input signals being at a power level less than an interference level with respect to the satellite input signals produced by the satellite receiving antenna at said location; and
- (c) transmitting terrestrial signals at the non-interfering power level and first transmission frequency from the first terrestrial transmitter to the effective transmission area.

17. The method of claim 16 wherein the step of determining the satellite signal power level includes the steps of:

- (a) receiving the signal transmitted from the satellite at the first transmission frequency; and
- (b) converting the signal transmitted from the satellite at the first transmission frequency to a representative signal which is representative of the satellite signal power level.

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18. The method of claim **17** wherein the step of setting the transmission power level for the first terrestrial transmitter includes the step of:

- (a) comparing the representative signal to a reference signal to produce a comparison output.

19. The method of claim **18** further including the step of:

- (a) using the comparison output to control the transmission power level for the first terrestrial transmitter.

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20. The method of claim **19** wherein the step of using the comparison output to control the transmission power level for the first terrestrial transmitter includes the step of:

- 5 (a) controlling a modulated signal level in the first terrestrial transmitter.

* * * * *



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(54) **APPARATUS AND METHOD FOR
PROCESSING SIGNALS SELECTED FROM
MULTIPLE DATA STREAMS**

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705, 734; 340/825.33, 825.35, 825.69, 825.72,
825.03; 370/310, 315, 334, 343, 480, 481,
482, 485, 486, 351, 360

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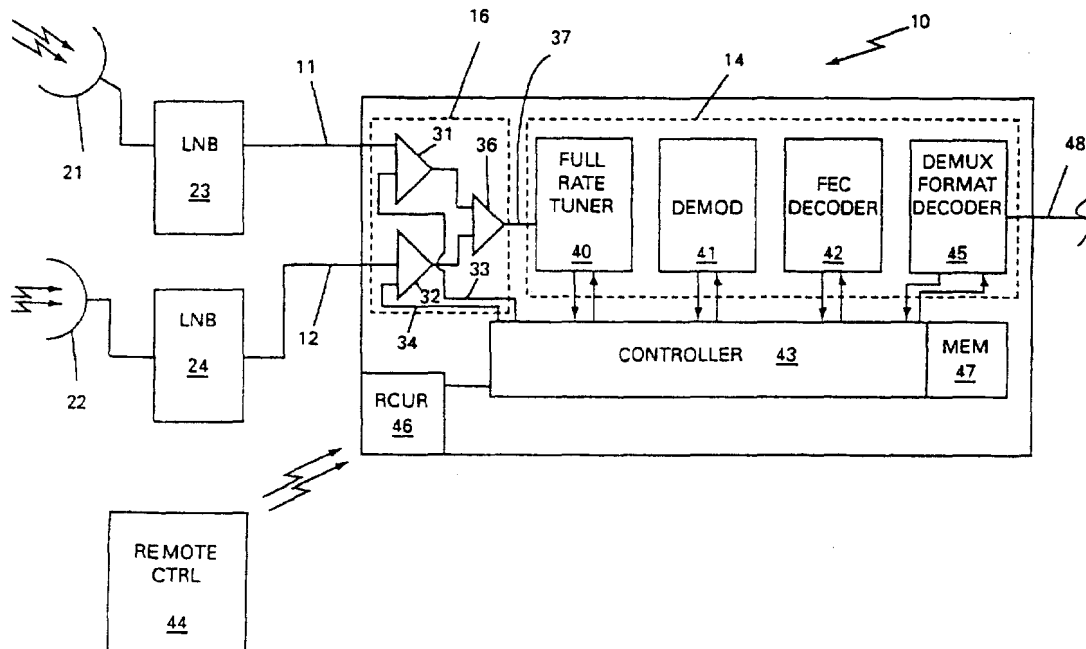
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(57) **ABSTRACT**

A multiple data stream processing arrangement includes a receiver/signal processor (14) and a plurality of signal input paths (11, 12) which meet at a junction (36). A junction output from the junction (36) provides a single input to the receiver/signal processor (14). A switching arrangement (16) is associated with the plurality of signal input paths (11, 12). The switching arrangement (16) includes a switch (31, 32) connected in each signal input path (11, 12). Each switch (31, 32) responds to an enable signal to allow a data stream applied to the respective input path (11, 12) to pass on to the junction (36) and to the receiver/signal processor (14). According to the invention only one signal input path (11, 12) and respective switch (31, 32) is enabled at any given time.

19 Claims, 1 Drawing Sheet



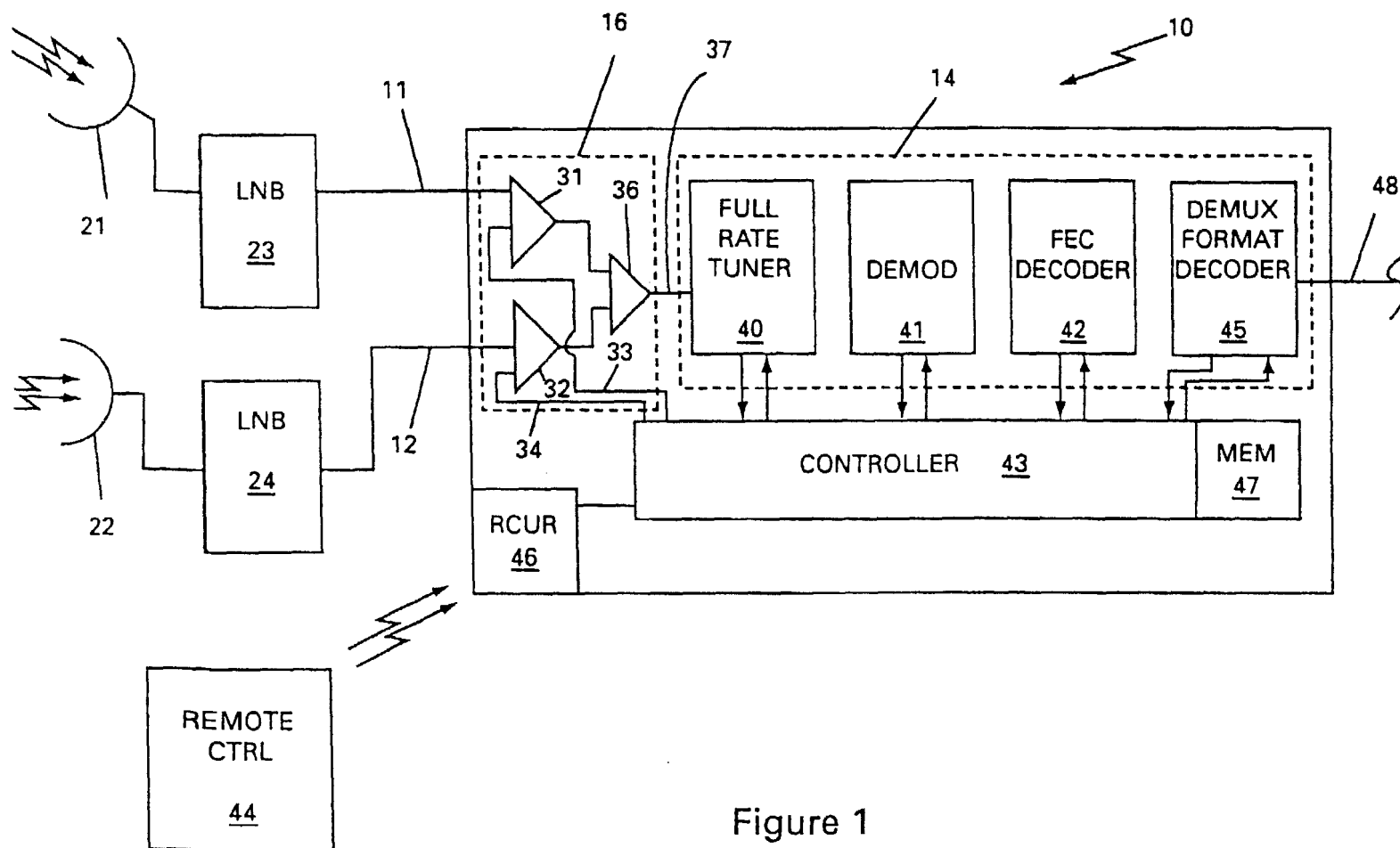


Figure 1

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APPARATUS AND METHOD FOR PROCESSING SIGNALS SELECTED FROM MULTIPLE DATA STREAMS

TECHNICAL FIELD OF THE INVENTION

This invention relates to digital data transmission and more particularly to an apparatus and method for selecting from multiple data streams to produce a single data output.

BACKGROUND OF THE INVENTION

Various types of information may be converted to a digital format and the digital data then transmitted to a user location as a radio frequency signal comprising a digital data stream. A single user location may be able to receive these digital radio frequency transmissions from multiple sources. For example, a user may receive signals directed from one or more terrestrial transmitters. Also, the same user may be able to receive digital radio frequency signals from one or more satellites. Regardless of the source of the radio frequency signals which comprise the digital data stream, each data stream must be processed at the user location to provide useful information.

Direct broadcast satellite (DBS) television transmission is one example of digital radio frequency transmission. In DBS transmission, digital signals on a number of different carrier frequencies are transmitted from a satellite and these multiple carrier frequencies together comprise a data stream. The frequency spectrum now allotted to DBS transmissions comprises the spectrum from 12.2 to 12.7 GHz. Each carrier frequency carries data for several different discrete outputs, which in the DBS example, comprise television channels. In order to use the DBS data stream, the entire data stream is picked up by a suitable antenna and the frequencies are down converted to an intermediate frequency below the radio frequency level. A receiver at the user location demodulates the desired carrier frequency and decodes the demodulated signals to produce a desired output comprising a channel input for a television set.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an apparatus and method for selecting from multiple data streams transmitted on one or more common frequencies and processing the selected data stream.

In order to accomplish this object, an apparatus according to the invention includes a plurality of signal input paths to a single receiver/signal processor. A switching arrangement associated with the signal input paths enables only one of the paths at a given time for communicating a data stream to the receiver/signal processor. Each signal input path may receive a separate data stream including signals at one or more frequencies which may or may not be common to frequencies for signals received on another one of the input paths. By enabling only one input path at a time, the switching arrangement prevents common frequency signals from interfering with each other. Furthermore all of the signals from each source may be processed by the single receiver/signal processor, thus avoiding duplicate signal processing equipment at the user location.

As used in this disclosure, the term "data stream" means digital data transmissions on one or more frequencies from a single source. The frequency or frequencies may be any frequency including radio frequencies and lower frequencies. For example, a data stream may comprise signals transmitted at radio frequencies from a satellite and may also

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comprise the same signals after down conversion to intermediate frequencies. Also, as used herein "data" shall mean any digital data and shall not be limited to data producing any particular type of output. For example, "data" may comprise the digital signals required to produce a television input for a standard television set. As another example, "data" may comprise digital signals representing Internet communications. As yet another example, "data" may comprise digital voice or telephone information.

The switching arrangement includes a suitable switching device connected in each input path. Each switching device is enabled for passing the data stream only in response to an enable signal supplied to the respective switching device. In the absence of an enable signal the respective switching device serves to block the data stream on the particular input path. The plurality of the input paths meet at a junction having a single output which is connected to the input of the receiver/signal processor. The receiver/signal processor receives signals from the single enabled input path and processes the signals in a manner well known in the art to produce a desired data output.

The apparatus according to the invention has associated with it a separate radio frequency receiving arrangement for each signal input path. Each radio frequency receiving arrangement includes a suitable antenna for receiving signals from a single transmission source. Each radio frequency receiving arrangement further includes a suitable down converter for converting the radio frequency signals to intermediate frequency signals. Each separate data stream of intermediate frequency signals is applied to a different one of the signal input paths to the processing apparatus according to the invention.

In the preferred form of the invention, the processing apparatus includes a controller for controlling the switching arrangement and the various components of the receiver/signal processor. The controller responds to a user entered select input which is associated with certain data within one of the input data streams which may be processed to produce a desired data output. In response to a select input, the controller retrieves from a memory device signal input information for controlling the switching arrangement and signal processing information for controlling the receiver/signal processor. The controller uses the signal input information to enable the signal input path which carries the data stream containing the data for the selected output. The signal processing information causes the receiver/signal processor to tune to the correct carrier frequency carrying the desired data, demodulate transmitted signals, and finally decode the demodulated signals to produce the desired data output.

These and other objects, advantages, and features of the invention will be apparent from the following description of the preferred embodiments, considered along with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic representation of a multiple data stream processing apparatus embodying the principles of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a multiple data stream processing apparatus 10 according to the invention receives one data stream on a first input path 11 and a separate and distinct data stream on a second input path 12. The apparatus 10 includes a receiver/signal processor 14 for receiving one of the two

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data streams and processing the data stream to produce a desired channel output from the received signals. A switching arrangement 16 allows only one data stream at a time to reach receiver/signal processor 14.

The apparatus 10 is located at a user location which may be any location which may receive data streams from multiple signal sources. The data streams comprise digital data transmitted from a signal source at suitable radio frequencies. Each data stream includes at least one carrier frequency and preferably several carrier frequencies. Each carrier frequency carries data which may be processed to produce at least one channel output. In most cases a single carrier frequency will carry data which may be processed to produce several different channel outputs. The term "channel output" is used in this disclosure for convenience to describe related data which may be used as an input to a television, computer, or other device to produce a desired output from that device. For example, the channel output may be a signal suitable for use by a television to produce a television presentation or program. However, the invention is not limited to use with data streams comprising signals for producing a television input. The term "channel" is used in this disclosure and the accompanying claims to describe certain data in an incoming data stream. Specifically, the "channel data" for a given channel output comprises the data which is used to produce that particular channel output.

In the illustrated example of the invention, signals from one radio frequency transmitter (not shown) are received at a first antenna 21. The signals comprising the transmitted data stream may be in any radio frequency range. For example, the radio frequency transmissions received by the first antenna may be in the range from 12.2 to 12.7 GHz, the frequency band currently allotted for DBS television transmissions. The radio frequency signals received at first antenna 21 are directed to a low noise block converter or LNB 23 where the signals are down converted to an intermediate frequency. The data stream at the intermediate frequency band is directed to the first input path 11 of processing apparatus 10. The intermediate frequency band may, for example, be approximately 950 to 1450 MHz. It is possible that the intermediate frequency could be within another frequency range, however this 950 to 1450 MHz range is useful for purposes of illustration because it corresponds to an intermediate frequency range produced from DBS signals transmitted at between 12.2 and 12.7 GHz.

Signals from a second radio frequency source (not shown) are received at a second antenna 22 and down converted by a second low noise block converter or LNB 24. LNB 24 converts the radio frequency signals to intermediate frequency signals and directs the intermediate frequency data stream to the second input path 12 of processing apparatus 10.

The invention is not limited to signals received from a particular type of signal source. For example, one source may be a satellite while the other radio frequency signal source may be a terrestrial transmitter. Alternatively, both radio frequency signal sources may be satellites or both may be terrestrial transmitters. In any case, the radio frequency signals received by first antenna 21 and second antenna 22 may include signals at the same carrier frequencies. Although in some cases the carrier frequencies received by the two radio frequency receiving antennae 21 and 22 may be identical, in other applications of the invention the two distinct sets of signals may include only a few of the same carrier frequencies or none of the same carrier frequencies and each set may include other carrier frequencies which are not included in the other set. Where the radio frequency

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transmissions received at the antennae 21 and 22 share at least one common frequency, the signals cannot all be combined on a single propagation path without interference. For example, the first antenna 21 may receive signals at a transmission frequency of 12.2 GHz. The second antenna 22 may receive signals transmitted at the same 12.2 GHz frequency but carrying entirely different data. In this case, if the signals from the two antennae 21 and 22 were combined on a common signal path, the common frequency signals would interfere with each other.

The two signal input paths 11 and 12 pass through switching arrangement 16. Switching arrangement 16 includes a first on/off amplifier or switch 31 connected in the first input path 11, and a second on/off amplifier or switch 32 connected in the second input path 12. First on/off amplifier 31 is connected to receive an enable signal through a first enable line 33 while second on/off amplifier 32 is connected to receive an enable signal applied on a second enable line 34. The output of first on/off amplifier 31 and the output of second on/off amplifier 32 are applied as inputs to a junction amplifier 36. Junction amplifier 36 produces a single junction output at output line 37. Elements 31 and 32 may comprise any suitable on/off amplifier or active switch while the junction amplifier 36 may comprise any suitable summing amplifier.

On/off amplifier 31 operates to pass the intermediate frequency signals or data stream received on input path 11 only when an enable signal is applied to the amplifier through enable input line 33. On/off amplifier 32 similarly operates to pass the intermediate frequency data stream received on input path 12 only when an enable signal is applied to the amplifier through enable input line 34. When an enable signal is not applied to the particular on/off amplifier 31 or 32, the particular amplifier does not pass the respective data stream on to junction amplifier 36. However, when either on/off amplifier 31 or 32 receives an enable signal through its respective enable line 33 or 34, the data stream on the associated input path is passed on to junction amplifier 36 for input to receiver/signal processor 14 through line 37. Junction amplifier 36 ensures that the signals are at the correct impedance for input to the receiver/signal processor 14. As will be discussed in detail below, only one of the on/off amplifiers 31 or 32 is enabled at a given time. Thus only one of the received data streams is applied as an input to receiver/signal processor 14 at any given time.

Receiver/signal processor 14 receives the single data stream from the junction amplifier 36 and produces a desired channel output similar to a direct broadcast satellite television set-top unit such as an RCA DSS receiver unit or a DVB format receiver unit. The receiver/signal processor 14 includes a full rate tuner and down converter 40, a demodulator 41, a forward error correction (FEC) decoder 42, and a demultiplexer/format decoder 45. Each of these elements is connected to and controlled by a controller 43 which, in the preferred form of the invention, comprises a suitable processor. A user may make a select input to controller 43 to select a desired channel output from signal processor 14. This select input may be entered through the illustrated remote control 44 and remote control signal receiver 46. In response to the select input, the controller 43 sends an enable signal to enable the on/off amplifier 31 or 32 associated with the input path carrying the desired channel data required to produce the desired channel output, thereby selecting the appropriate data stream. The selected data stream is input to receiver/processor 14 and the controller 43 controls the tuner 40 to tune to the particular carrier frequency containing the

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desired channel data. Tuner 40 then passes this selected carrier frequency to demodulator 41 which demodulates the selected carrier frequency signal to produce signals comprising all data carried on that particular carrier frequency. This data, which may commonly include data for several different channel outputs, is passed to FEC decoder 42 which operates under the control of controller 43 to correct for digital data errors which may have occurred in transmission. The demultiplexer/format decoder 45 then operates under the control of controller 43 to decode the data and separate out the desired channel data from other data to produce the desired channel output. The selected channel output is directed through output line 48 to the equipment (not shown) which may utilize the channel output, such as a television set or computer, for example.

A memory device 47 associated with controller 43 stores information required for controlling the various components of receiver/signal processor 14 and also information for the switching arrangement 16. The stored information includes a channel identifier unique to a particular channel at that point output formed from the channel data included in one of the data streams received on input paths 11 or 12. For each channel identifier the memory device 47 stores signal path information identifying which on/off amplifier 31 or 32 to enable for passing the desired data to the receiver/signal processor 14. For each channel identifier, memory device 47 also stores signal processing information comprising all control information required by tuner 40, demodulator 41, FEC decoder 42, and demultiplexer/format decoder 45 in order to produce the desired channel output. This signal processing information and the manner in which the tuner 40, demodulator 41, FEC decoder 42, and demultiplexer/format decoder 45 operate are well-known in the art and will not be discussed in detail here.

It will be noted that the apparatus 10 illustrated in FIG. 1 is shown only for convenience in describing the invention. Numerous modifications to the illustrated apparatus 10 may be made within the scope of the invention and the following claims. For example, although two input paths are shown in FIG. 1, any number of input paths may be included in an apparatus embodying the principles of invention. Furthermore, the invention is not limited to any particular radio frequency bands or to any particular intermediate frequency bands.

Another important aspect of the invention is that the signals on the two different input paths 11 and 12 may carry data in entirely different formats such as the DSS, DVB, or MPEG2 formats, for example. As long as the memory device 47 stores the particular signal processing information for allowing demultiplexer/format decoder 45 to decode the data, there is no limit as to the particular data format which may be processed by apparatus 10.

Another variation from the form of the invention shown in FIG. 1 relates to switching arrangement 16. Although the switching arrangement is shown as being integrated with receiver/signal processor 14, the switches can comprise any suitable device for selectively blocking the respective data stream and may be located anywhere in the paths from the respective receiving antennae 21 and 22 to the junction amplifier 36. These variations in switch positions should be considered equivalent to the switching arrangement illustrated in FIG. 1. Of course, if the switching arrangement is not controlled by controller 43, some other arrangement must be included for enabling the desired switch. For example, a simple manual switch may be used to control the particular switching device and enable the desired data stream to the pass on to the receiver/signal processor 14.

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A user selects a particular channel output which may include a television channel or some other type of data, by providing a select input to the controller 43 through user input device 44. The controller 43 responds to the select input by accessing the memory device 47 to retrieve the required operational information. The controller 43 locates the channel identifier corresponding to the desired channel output identified by the select input and recalls all of the information required to enable the apparatus 10 to process the incoming data to produce the desired channel output. This information includes signal input information which allows the controller 43 to enable the appropriate on/off amplifier 31 or 32, and enable only the desired data stream to pass on to the receiver/signal processor 14. The information retrieved from the memory device 47 also includes signal processing information for controlling the operation of tuner 40, demodulator 41, FEC decoder 42, and demultiplexer/format decoder 45 to process the selected data stream and produce the desired channel output at output line 48. Since only one signal input path is enabled at any given time, the multiple data streams do not interfere with each other even if they include signals at one or more common frequencies.

The above described preferred embodiments are intended to illustrate the principles of the invention, but not to limit the scope of the invention. Various other embodiments and modifications to these preferred embodiments may be made by those skilled in the art without departing from the scope of the following claims.

What is claimed is:

1. An apparatus for receiving multiple data streams, the apparatus comprising:

- (a) a first switch connected to a first input and having a first switch output, the first switch adapted to be selectively enabled for passing a first stream of data signals from the first input to the first switch output, the first stream of data signals including first channel data;
- (b) a second switch connected to a second input and having a second switch output, the second switch adapted to be selectively enabled for passing a second stream of data signals from the second input to the second switch output, the second stream of data signals including second channel data different from the first channel data;
- (c) a data stream junction connected to the first switch output and the second switch output and having a junction output;
- (d) a controller for receiving a channel select input related to a desired channel output to be formed from one of the first channel data or second channel data, and, in response to the channel select input, for enabling the one of the first switch or the second switch which receives the stream of data including the channel data from which the desired channel output is to be formed; and
- (e) a memory device operatively connected to the controller, the memory device storing first signal input information indicating the respective switch through which the first channel data is received and further storing second signal input information indicating the respective switch through which the second channel data is received.

2. The apparatus of claim 1 further comprising:

- (a) a signal processor connected to receive data signals from the data stream junction; and
- (b) wherein the controller controls the operation of the signal processor to produce the desired channel output from data signals received from the data stream junction.

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3. The apparatus of claim 2 wherein the memory device also stores:

- (a) first signal processing information to control the processing of the first channel data; and
- (b) second signal processing information to control the processing of the second channel data.

4. The apparatus of claim 3 wherein the memory device stores additional channel output information including (i) additional processing information to control the processing of additional channel data and (ii) additional signal input information indicating the switch through which the respective additional channel data is received.

5. The apparatus of claim 2 wherein the signal processor includes:

- (a) a tuner;
- (b) a demodulator;
- (c) a forward error correction decoder; and
- (d) a demultiplexer/format decoder.

6. The apparatus of claim 1 wherein the data stream junction comprises:

- (a) an impedance matching amplifier.

7. The apparatus of claim 1 wherein:

- (a) the first input receives signals on a plurality of first carrier frequencies; and
- (b) the second input receives signals on at least one of the first carrier frequencies.

8. An apparatus for receiving multiple data streams, the apparatus comprising:

- (a) a plurality of input paths, each respective input path for carrying a different data stream;
- (b) a switching structure associated with the plurality of input paths for selectively blocking the respective data stream on each different input path;
- (c) a controller for receiving a channel select input related to a desired channel output to be formed from data included in one of the different data streams, and for responding to the channel select input by blocking at least one of the plurality of data streams which does not include the channel data from which the desired channel output is to be formed; and
- (d) a memory device operatively connected to the controller, the memory device storing channel output information for each different channel output which may be produced from the plurality of data streams, the channel output information for each respective channel output including signal input information indicating the input path on which the respective channel data is carried.

9. The apparatus of claim 8 further comprising:

- (a) a signal processor; and
- (b) wherein the controller controls the operation of the signal processor to produce the desired channel output from the data included in one of the different data streams.

10. The apparatus of claim 9 wherein the channel output information for each respective channel output further includes signal processing information to control the signal processor in processing the respective channel data.

11. The apparatus of claim 10 wherein the channel output information for each respective channel output is related to a unique channel identifier in the memory device.

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12. The apparatus of claim 9 wherein the signal processor includes:

- (a) a tuner;
- (b) a demodulator;
- (c) a forward error correction decoder; and
- (d) a demultiplexer/format decoder.

13. The apparatus of claim 8 wherein:

- (a) each data stream comprises signals from a different antenna.

14. The apparatus of claim 8 wherein:

- (a) at least two of the data streams include signals on a common carrier frequency.

15. A method for receiving multiple data streams, the method comprising the steps of:

- (a) directing a plurality of different data streams each along a different input path to a signal processor, each the data stream including channel data for producing a respective channel output;
- (b) receiving a channel select input relates to a desired channel output comprising a particular one of the channel outputs;
- (c) responding to the channel select input by blocking at least one of the data streams which does not include channel data from which the desired channel output is to be produced; and
- (d) storing channel output information for each different channel output which may be produced from the plurality of data streams, the channel output information for each respective channel output including signal processing information to control the signal processor in processing the respective channel data, and signal input information indicating the input path on which the respective channel data is carried.

16. The method of claim 15 further comprising the steps of:

- (a) in response to the channel select input, accessing the stored channel output information for the desired channel output; and
- (b) controlling the operation of the signal processor with the signal processing information for the desired channel output.

17. The method of claim 16 further comprising the step of:

- (a) utilizing a channel identifier uniquely associated with the desired channel output in accessing the channel output information for the desired channel output.

18. The method of claim 15 wherein:

- (a) each data stream utilizes at least one common carrier frequency.

19. The method of claim 16 wherein the step of controlling the operation of the signal processor includes the steps of:

- (a) tuning the signal processor to the carrier frequency of the channel data for producing the desired channel output;
- (b) demodulating the signals at that carrier frequency; and
- (c) decoding the demodulated signals to identify and select the channel data.

* * * * *



United States Court of Appeals,
Federal Circuit.

STATE INDUSTRIES, INC., Appellee,
v.
A.O. SMITH CORPORATION, Appellant.

Appeal No. 84-590.

Jan. 3, 1985.

Defendant appealed from order of the United States District Court for the Middle District of Tennessee, Thomas A. Wiseman, Jr., Chief Judge, finding patent relating to water heater designed to reduce sediment buildup valid and wilfully infringed. The Court of Appeals, Rich, Circuit Judge, held that the patent was valid and infringed, but the infringement was not wilful.

Affirmed in part and reversed in part.

West Headnotes

[1] Patents ⚙️ **324.55(2)**
291k324.55(2)

Review by Court of Appeals of trial court's fact findings mandated by statute in patent infringement action is limited to determining whether they were clearly erroneous in light of the evidence. 35 U.S.C.A. § 103.

[2] Patents ⚙️ **314(6)**
291k314(6)

In action in which Patent No. 4,263,879, relating to a water heater designed to reduce sediment buildup, was found to have been valid and infringed, district court correctly determined scope and content of prior art and differences between claimed invention and prior art.

[3] Patents ⚙️ **90(1)**
291k90(1)

Alleged infringing party failed to prove that water heater patent was invalid because of a sale more than a year before the United States patent application was filed in this country in that he failed to prove that district court was incorrect in holding that holder of the patent was entitled to benefit of its earlier filing date; alleged infringing party failed to

prove that newly added matter in the application was not adequately disclosed in the earlier application in manner required by statute. 35 U.S.C.A. §§ 102(b), 112, 120.

[4] Patents ⚙️ **235(2)**
291k235(2)

District court was not clearly erroneous in finding that patent for water heater designed to reduce sediment buildup was infringed.

[5] Patents ⚙️ **227**
291k227

Although patent relating to water heater designed to reduce sediment buildup was valid and infringed, the infringement was not wilful.

[6] Patents ⚙️ **227**
291k227

To wilfully infringe a patent, the patent must exist and one must have knowledge of it, and a "patent pending" notice gives one no knowledge whatsoever.

[7] Patents ⚙️ **325.11(3)**
291k325.11(3)

Because infringement of patent relating to water heater was found not to have been wilful, the case was not an exceptional one justifying award of attorney fees. 35 U.S.C.A. § 285.

Patents ⚙️ **328(2)**
291k328(2)

4,263,879. Relating to water heater designed to reduce sediment buildup was valid and infringed.

*1227 Glenn O. Starke, Andrus, Sceales, Starke & Sawall, Milwaukee, Wis., argued, for appellant. With him on the brief was Gary A. Essmann, Milwaukee, Wis.

Paul R. Puerner, Michael, Best & Friedrich, Milwaukee, Wis., argued, for appellee. With him on the brief was Glenn A. Buse, Milwaukee, Wis.

Before RICH, BALDWIN and KASHIWA, Circuit Judges.

RICH, Circuit Judge.

This appeal is from the October 5, 1983, Order of the United States District Court for the Middle District of Tennessee, Nashville Division, 221 USPQ 958 (1983). The court, sitting without a jury, held appellee's Lindahl patent No. 4,263,879 ('879), issued April 28, 1981, for "Water Heater," valid and willfully infringed. We affirm the holdings of validity and infringement, and reverse the holding that infringement was willful.

Background

State Industries, Inc. (State), which manufactures and sells industrial water heaters under its SANDBLASTER mark, sued its competitor A.O. Smith Corporation (Smith), which manufactures and sells a similar water heater under its LIME TAMER mark. The patent in suit is for a water heater designed to reduce sediment buildup, i.e., minerals such as lime, in the water heater tank. Sediment buildup reduces efficiency and eventually may cause tank failure.

The preferred embodiment of the invention is shown in Figs. 1 and 2 of the patent, reproduced below:

*1228

<Image 1 (4x5.5) is available via Offline Print to FAX>

Fig. 1 is a sectional elevation of the water heater and Fig. 2 is a section on the line 2-2 of Fig. 1 showing the agitator assembly mounted in the bottom portion of the tank 22. Flue tubes 20 conduct hot gas from burner 15 through the water. The agitator assembly 28 includes a ring-shaped tubular member 30 positioned in the bottom of the tank closely adjacent to its side wall 10 and a secondary tubular member 32, connected to the ring-shaped member 30, which extends horizontally toward the center of the tank. Tubular member 30 has several small holes 34 and several venturi fittings 46 all directed toward the center of the tank at a level closely adjacent to the bottom of the tank. These openings are positioned so that the streams of water flowing from them are directed over and adjacent to the bottom of the tank.

The secondary tubular member 32 has several small holes 35 and, near its inner end an upwardly directed venturi fitting 47, which enhance the desired stirring action and help suspend the sediment in the center of the tank.

Thus, when hot water is withdrawn through outlet 42 at the top of the tank, cold water simultaneously flows into, and out of the openings in, the agitator assembly. The combined action of the water flowing from the openings in that assembly stirs up and suspends sediment which has settled to the bottom of the tank and ultimately carries it upward and out through the hot water outlet 42.

The '879 patent contains eight claims of which only claims 7 and 8 are relied on. Claim 7, directed to the water heater structure, is exemplary. It reads (paragraphing added):

7. A water heater comprising:

a water tight tank means adapted to contain water under pressure;

a source of heat for heating water inside said tank means;

a hot water outlet means located in the top portion of said tank means for periodically withdrawing heated water from the top portion of said tank means;

*1229 an agitator assembly means mounted in the bottom portion of said tank, said agitator assembly means including

a tubular member connected to a source of water under pressure to be heated,

said tubular member extending into said water tight tank means,

said tubular member being imperforate other than having a plurality of small openings therein spaced along the length thereof to direct multiple streams of water under pressure into the tank each time water is drawn out of the top portion of said tank means through said hot water outlet means,

said plurality of openings in said otherwise imperforate tubular member positioned so that said multiple streams of water will be directed over and adjacent to the bottom of the tank means to create a stirring action in the lower portion of said tank means to thereby cause solid materials which have either settled to the bottom or are in the process of settling to the bottom to be maintained in suspension in the water so that ultimately at least a portion of said materials will be carried upwardly in said tank means and out said hot water outlet means,

the relationship of the aggregate size of the small openings in said otherwise imperforate tubular member to the size of said tubular member itself is such that the velocity of the water flowing into said tank means through said plurality of openings in said tubular member is greater than the velocity of water flowing into said tubular member from

the source of cold water under pressure to thereby create the desired stirring action in the bottom portion of said tank means.

Claim 8 is directed to a method of heating and circulating water in the tank of claim 7.

The district court held that '879 patent valid and infringed by Smith's LIME TAMER water heater, which is illustrated in Smith's Cook patent No. 4,257,355, of which Figs. 2 and 4 are reproduced below.

<Image 2 (2.75X 5.25X) is available via Offline Print to FAX>

Cold water is introduced into the tank through inlet tube 16, located in the bottom of the tank and discharging downwardly against the lower head 3 of the tank through openings 23. Fig. 4, which is an enlarged cross-section of inlet tube 16, shows the openings 23 located at about a 45 <<degrees>> angle to the tank bottom 3. In addition, water is discharged upwardly along the central axis of the tank through a *1230 single upwardly-facing opening 24. The holes 23 and 24 are so located as to "agitate sediment in the bottom of the tank and prevent build up of sediment deposits on the inner surface of the lower head of the tank," to quote from Smith's patent.

In reaching its determination of infringement, the district court found as fact:

44. It is the finding of this Court that the multiple streams of water flowing from the openings in the Lime Tamer inlet tube are directed over and adjacent the bottom of the tank to produce the desired stirring action as defined in claims 7 and 8 of the '879 patent-in-suit.

89. Other than for the configuration of the inlet tube, the patented Sandblaster water heater and the accused Lime Tamer water heater are very similar. They both operate in the same manner to produce the same results and thus, the Lime Tamer heater is a substantial copy of the Sandblaster heater.

With respect to the district court's holding of willful infringement it found as fact:

128. Defendant Smith, upon the appearance of the Sandblaster water heater on the market, initiated a crash program to develop a Sandblaster equivalent resulting in the manufacture and sale of the accused Lime Tamer water heater * * *.

Defendant, Smith, proceeded with the manufacture and sale of the accused Lime Tamer water heater after receiving notice of infringement from State without obtaining an opinion of counsel regarding infringement or validity of the '879 patent-in-suit * * *.

Smith argues before us, as it did below, that the '879 patent is invalid under 35 U.S.C. § 102(b) because of a sale of a heater embodying the claimed invention more than one year before the filing of the application for the patent in suit, notwithstanding the holding below that the patent is entitled to the filing date of a parent application which matured into State's patent No. 4,157,077 ('077), which was within the one-year period of the statute.

Issues on Appeal

Did the District Court err in holding:

1. The invention defined in claims 7 and 8 of the '879 patent would not have been obvious from the prior art.
2. The '879 patent is entitled to the filing date of application serial No. 854,721 (now State's '077 patent), of which it is stated to be a continuation-in-part.
3. Smith has infringed claims 7 and 8.
4. Smith's infringement was willful.

OPINION

1. Obviousness

Smith contends that the district court incorrectly determined the scope and content of the prior art and the differences between the claimed invention and the prior art.

[1] Our review of the trial court's fact findings mandated by 35 U.S.C. § 103, however, is limited to determining whether they were clearly erroneous in light of the evidence. *Kimberly-Clark Corp. v. Johnson & Johnson*, 745 F.2d 1437, 1444, 223 USPQ 603, 606 (Fed.Cir.1984).

[2] With respect to Smith's criticism of the district court's analysis of the prior art, Smith relies primarily on the Smith B-97 water heater, sold from 1959 to 1962, and the National Steel Construction Company (National) water heater, which were not before the Patent and Trademark Office during

prosecution of the application for the '879 patent.

The construction of the B-97 water heater is illustrated in Smith's exhibit 106, below.

*1231

< Image 3 (4.25x5.5) is available via Offline
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This heater has a 5 1/8 inch long cold water inlet tube with 8 openings directed upward at an angle of 15 <<degrees>> or 20 <<degrees>>. The most inward pair of holes is only 4 inches from the tank wall.

Smith argues that the trial court ignored the testimony of its expert, Robert Cook that: "The size and position of the openings [provided] * * * agitation action to aid in dislodging and removing sediment or lime build-up on the lower head of the tank." This is simply reargument of an assertion with respect to which the district court stated, in part:

61. The inlet tube of the B-97 heater does not direct multiple streams of water over and adjacent the bottom of the tank to create a stirring action in the lower portion of the tank to thereby prevent sediment build-up across the bottom of the tank. Because the B-97 inlet tube extends into the tank only 5 1/8 inches in a 20 in. or a 24 in. internal diameter tank, there could be little or no agitation of sediment beyond the end of the 5 1/8 in. inlet tube * * *. Also because the total size of the upwardly directed openings in the tube was approximately equal to or greater than the size of the tube itself, the velocity of the streams of water coming out of the openings would be low, i.e., the velocity of the streams would be approximately equal to or less than the velocity of water flowing through the tube itself.

We are unpersuaded by Smith that the trial court was clearly erroneous in its findings regarding the B-97 heater.

The National water heater is shown in the sketch below:

*1232

< Image 4 (2.5x5.5) is available via Offline
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It is an electric heater having a horizontal tank and a cold water inlet referred to as a "diffusing pipe" with

openings directed *upward* at an angle of 45 <<degrees>>.

Smith argues:

The significance of the National heater is that it shows the concept of introducing cold water through a perforated, closed-end inlet tube simultaneously with the withdrawal of hot water, with the cold water being discharged through a plurality of holes toward the area of the tank where harmful lime buildup can occur i.e. *on the heating elements* in an electrical heater. [Emphasis ours.]

To the contrary, Mr. Dirk Eisinga, president of National when the National heater in question was developed, who supervised the design and development of the National heater, testified:

The stirring action is what we were trying to avoid. We tried to minimize it to whatever extent we could by reducing the velocity. I'm sure there was some stirring action but the purpose was to eliminate it.

The district court apparently accepted Eisinga's testimony, finding as fact:

67. The purpose of the diffusing pipes in the National Steel water heater is to bring the incoming water in very slowly and gently and to spread it out over the entire bottom of the tank to thereby prevent excessive mixing of the cold water with the previously heated water stored in the tank, i.e., the purpose was to avoid producing a stirring action as much as possible * * *.

The district court, in the best position to judge the testimony and evidence, found that the National heater taught away from the invention claimed in the '879 patent.

We are not persuaded by Smith that the district court was clearly erroneous in its evaluation of the National heater's significance.

2. On Sale Bar to the '879 Patent Under § 102(b)

[3] Appellant continues to argue that claims 7 and 8 of the '879 patent are invalid under 35 U.S.C. § 102(b) because of a sale more than a year before the U.S. patent application was filed in this country. The '879 patent states on its face that it is a continuation-in-part of the application for U.S. patent No. 4,157,077 which issued on an application filed November 25, 1977. State is the assignee

named in the '077 patent. The first sale of the SANDBLASTER heater encompassing the invention claimed in the '879 patent occurred in September 1977, over a year prior to the '879 patent application's filing date of February 1, 1979. Therefore, if claims 7 and 8 are to be saved from the bar, the specification of the '077 patent must contain a disclosure of the subject matter of those claims. Smith states in its reply brief:

*1233 The issue is whether the "otherwise imperforate" and "size relationship" limitations of claims 7 and 8 are supported by the disclosure of the original '077 patent. If not, the claims are invalid as a matter of law under 35 U.S.C. § 102(b).

Smith further says:

This defense is not based on an adequacy of disclosure defense under § 112, although the two could be related. [Emphasis ours.]

We hold that Smith's assertion as to the role of 35 U.S.C. § 112 in this type of § 102(b) defense is incorrect as a matter of law.

Smith has the burden to prove that the district court was incorrect in holding that State was entitled to the benefit of its earlier filing date under 35 U.S.C. § 120, which provides in part:

An applicant for patent for an invention *disclosed in the manner provided by the first paragraph of section 112* of this title in an application previously filed in the United States ... by the same inventor shall have the same effect, as to such invention, as though filed on the date of the prior application [Emphasis ours.]

For example,

If matter added through amendment to a C-I-P application is deemed inherent in whatever the original parent application discloses, ... that matter also is entitled to the filing date of the original, parent application. [*Litton Systems, Inc. v. Whirlpool Corp.*, 728 F.2d 1423, 1438, 221 USPQ 97, 106 (Fed.Cir.1984).]

Therefore, to prevail, Smith must prove that the newly added matter in the C- I-P application was not adequately disclosed in the earlier application in the manner required by the first paragraph of § 112. *Pennwalt Corp. v. Akzona Inc.*, 740 F.2d 1573, 1578, 222 USPQ 833, 836 (Fed.Cir.1984). [FN*] We find Smith's argument unpersuasive and decline to reverse the district court's reasoned analysis

which fully analyzes the facts and holds claims 7 and 8 supported in the parent application.

FN* *Litton* and *Pennwalt* are factually very different from the instant case. In both cases, this court held that the patentee was estopped by acquiescence from arguing whether the new matter contained in the C-I-P was adequately supported in the parent, according to the first paragraph of § 112.

In *Litton*, there was a PTO new matter rejection, based on words added in a 37 CFR 1.60 application, which prompted the C-I-P application. This court held that the patentee, without a written statement in the record pursuant to 37 CFR 1.133, was estopped from arguing that the C-I-P application, filed in response to the new matter rejection, did not contain new matter.

Similarly, in *Pennwalt*, the patentee, in response to a § 112, first paragraph, rejection, filed the parent C-I-P application and abandoned the grandparent application. This court held that the filing of a C-I-P application in response to a § 112 rejection is prima facie evidence of acquiescence in the PTO's rejections, but that did not preclude the patentee from going forward with evidence to show that it did not acquiesce. This court went on to hold that the patentee failed to present evidence that it did not acquiesce, and therefore, because estoppel applied, it was unnecessary to determine the sufficiency of the grandparent disclosure. Here, unlike *Litton* and *Pennwalt*, there was no PTO rejection prompting the C-I-P; rather, State filed the C-I-P to broaden its claims to better cover Smith's allegedly infringing device.

Infringement

[4] The parties agree that infringement hinges on whether Smith's LIME TAMER water heater openings in the water inlet tube are positioned so that "multiple streams of water will be directed over and adjacent the bottom of the tank," as recited in the claims in suit.

Smith argues that "the incoming water is directed downwardly at an angle of about 45 < <degrees> > to the horizontal, as well as being discharged vertically upward through a single outlet. The incoming water in the LIME TAMER heater which is directed downwardly, impinges or blasts directly on the lower head of the water heater to scrub the bottom of the tank." In summary, Smith contends that since its heater directs water "downwardly" instead of "over and adjacent," its

structure is sufficiently distinguishable from the language of the claims, so as to preclude infringement.

***1234** In considering this identical argument, the district court found as fact:

129. Defendant Smith's position regarding infringement is untenable. The Sandblaster and Lime Tamer water heaters operate in the same manner to produce the same result. Smith's expert, Robert E. Cook, acknowledged that the streams emanating from the Lime Tamer inlet tube "scrub" the bottom of the tank and "boil over" the bottom of the tank. This is tantamount to acknowledging that the streams are directed over and adjacent the bottom of the tank as specified in the claims.

And it made the following "conclusion of law":

54. * * * Smith's contention that the Lime Tamer heater does not infringe the claims in issue because it does not direct the streams "over and adjacent to the bottom of the tank means" defies basic fundamentals of fluid flow and, consequently, is totally lacking in merit.

Smith, repeating its trial court contention, has failed to show this court *why* the district court was clearly erroneous in finding that Smith's water heater directs its cold water streams "over and adjacent" the bottom of the tank.

Having carefully considered appellant's arguments on the infringement issue, we find no reason to disturb the district court's well-supported decision thereon.

4. *Willful Infringement and Trebled Damages*

[5] We find State's case for willful infringement, on which it persuaded the district court to adopt its proposed findings of fact and conclusions of law verbatim, to be fatally flawed as based on a mixture of fact with non-fact and erroneous legal presumptions. For purposes of discussion, it is essential first to review the chronology of undisputed events related to the development of Smith's LIME TAMER heater and to State's acquisition of patent rights.

November 25, 1977, John R. Lindahl (assignor to State) filed his first patent application on State's SANDBLASTER HEATER, serial No. 854,721, containing disclosure which has been found to

support the claims in suit. It was, of course, maintained in secrecy by the Patent and Trademark Office (PTO) until June 5, 1979, when it matured into patent '077. All claims of that patent are limited to a *ring-shaped* water-inlet pipe, or "agitator," and have never been asserted against Smith whose "agitator" is not ring shaped.

Prior to August 1, 1978, State introduced to the market its SANDBLASTER heater (first sale stipulated to have been September 12, 1977) with accompanying literature which stated, among other things, by way of the not uncommon footnote statement, "Patent Applied For." This was referenced by the asterisk in the following statement:

New exclusive feature * of Sandblaster water heater reduces build-up of sand, lime and sediment.

This was the totality of Smith's information on any "patent position" by State on the invention at bar until the commencement of this suit. It was aware only of that notice, not of any patent application.

Smith, being a longtime competitor of State's in the water-heater business, of course became aware of the SANDBLASTER and on August 1, 1978, Smith's general product manager sent an internal memo to certain company personnel stating:

The feature described in the attached State literature "could" have serious implications relative to our commercial water heater warranty administration. Thus, we have asked R.C. Anderson to purchase a heater for our evaluation.

That SANDBLASTER heater was obtained sometime prior to October 5, 1978, and, it hardly need be said, was carefully examined and tested.

In the full flush of competitive spirit, Smith then proceeded to design, test, and market its LIME TAMER heater, the designer being Robert E. Cook, Director of Product Engineering and Development in the A.O. Smith Company, also one of its expert witnesses in this litigation.

***1235** State repeatedly asserts, and persuaded the district court to hold, in effect, that Smith "copied" the SANDBLASTER heater. Attention is directed, however, to the early part of this opinion describing the two heaters and illustrating the substantial and apparent differences in the structures of the water inlet plumbing. They show that Smith clearly *did not copy* State's water inlet structure, but devised its

own quite different structure. Instead of the Lindahl "agitator assembly" (see claim 8, *supra*) consisting of a circular inlet pipe containing *horizontally-directed* openings and venturi nozzles plus a single radial pipe going to the center of the tank with more of the same, as in the SANDBLASTER put on the market, Smith's LIME TAMER has one *straight* water inlet tube with a plurality of orifices directed *angularly downward* and a single orifice directed upward in the center of the tank.

While justifiably denying copying, Smith candidly concedes in its brief before us that "the appearance of the plaintiff's Sandblaster heater on the market spurred the defendant, Smith, into activity to design a competing product." Having designed its own product, Smith proceeded through its outside patent counsel to obtain advice on its possible patentability, filed an application, and eventually obtained a patent (Cook patent No. 4,257,355)--facts which State attempts to turn to its own benefit in various ways but which we consider wholly irrelevant to the issue of willful infringement under discussion.

February 1, 1979, Lindahl filed another patent application, serial No. 8,275, which, as filed, stated that "This invention is an improvement in the invention described and claimed in" his November 25, 1977, application. The "improvement" was the upwardly directed venturi 47 on pipe 32 to which all claims of patent '879 except the two in suit are specifically limited. This is the application that matured into the patent in suit. It was stipulated in a pretrial order that, *as filed*, all claims of this second application were also limited to a ring-shaped agitator assembly. It was further stipulated that on July 30, 1979, representatives of State inspected an A.O. Smith LIME TAMER heater following which claims *not* limited to a ring-shaped agitator were first introduced into application 8,275. A more detailed statement about this appears in an amendment to that second application dated November 19, 1979, when the application was amended to state that it was a continuation-in-part of the November 25, 1977 application, in order to get that filing date under 35 U.S.C. § 120, *and to add broader claims*. We quote the attorney's "Remarks" accompanying the amendment:

The addition of new Claims 7-10 was prompted by an inspection on July 30, 1979 by Applicant's attorney of a water heater manufactured by a competitor of Applicant's assignee. Such competitor's water heater employed an agitator

assembly which was comprised solely of a single straight tube portion 32 of the present invention.

The departure of that statement from fact is apparent. Smith's inlet pipe or agitator is not "the straight tube portion 32 of the [Lindahl] invention" the openings in which are horizontally directed, whereas Smith's are directed angularly downward. Claims 7-10 submitted that day are all marked as cancelled by a later amendment "D", but the applicant was on his way to getting the claims in suit, expressly drafted to cover the LIME TAMER heater after it had been inspected. Thus, we see the familiar picture of competitors competing, one trying to match a new product of the other with a new product of its own, *not copied* but doing the same job, and the other manipulating its secret pending patent application to cover the functionally competitive structure it did *not* think of but deems to embody its proprietary "inventive concept." This is a classic commercial gamesmanship under the patent system but it is not the kind of behavior courts have categorized in the past as *willful infringement*, which requires knowledge of the patent.

Conduct such as Smith's, involving keeping track of a competitor's products and designing new and possibly better or *1236 cheaper functional equivalents is the stuff of which competition is made and is supposed to benefit the consumer. One of the benefits of a patent system is its so-called "negative incentive" to "design around" a competitor's products, even when they are patented, thus bringing a steady flow of innovations to the marketplace. It should not be discouraged by punitive damage awards except in cases where conduct is so obnoxious as clearly to call for them. The world of competition is full of "fair fights," of which this suit seems to be one.

To conclude the chronology of events, the lower court found as a fact that Smith's LIME TAMER heater was put on the market in April of 1981, and the parties agree about that. (The joint appendix and briefs before us do not disclose how State's attorney got to see it a year and nine months earlier except that the heater was "on test in Texas.") April 28, 1981, the patent in suit issued and this suit was commenced 22 days later on May 20, 1981.

It was stipulated in the pretrial order that "The plaintiff did not notify the defendant of the alleged infringement of patent 4,263,879 [in suit] prior to filing the complaint in the present action."

It bears repeating that it was not until November 19, 1979, that State commenced its efforts in the PTO to obtain claims which would *cover* the agitator structure in the LIME TAMER, which structure it did not invent or disclose in either of its patents, that its patent containing those claims issued April 28, 1981, *after* the LIME TAMER had been placed on the market, and that the LIME TAMER had been designed and built and was being tested before the progenitors of claims 7 and 8 in suit were submitted to the PTO, Smith being in the dark about State's patent application prosecution activity and knowing nothing about State's patent until it was sued.

[6] Against this factual background, we are constrained to agree with Smith that there can be no "willful infringement." To willfully infringe *a patent*, the patent must exist and one must have knowledge of it. A "patent pending" notice gives one no knowledge whatsoever. It is not even a guarantee that an application has been filed. Filing an application is no guarantee any patent will issue and a very substantial percentage of applications never result in patents. What the scope of claims in patents that do issue will be is something totally unforeseeable.

We have carefully considered the arguments in State's brief and find them totally unpersuasive and sometimes incomprehensible. For example, it asserts that Smith "never sought the opinion of counsel regarding infringement or validity of the '879 patent-in-suit," although it stipulated that it never gave Smith notice of the patent before suit and well knowing that suit was commenced within 22 days of the issue of that patent. Surely, once suit was commenced Smith took counsel and this suit manifests substantial and close questions on both validity and infringement. We turn now to some specific points on which the trial court erred.

After adopting a number of proposed Conclusions of Law which correctly analyze the case law on willfulness, the trial judge adopted Conclusion of Law 54 stating that the record supports "a conclusion that all the essential elements of State's Sandblaster water heater had been faithfully imitated by Smith in constructing its Lime Tamer water heater." We find this statement to be clearly contrary to the evidence. It may be noted that the two competitors' water heaters have, indeed, many *elements* in common, and common to the art as well--tanks, heaters, flues, inlets, and outlets--but the only *novel* parts of the structure contributed by Lindahl, the

agitator plumbing, were not "faithfully imitated" by Smith. The first patent issued on Lindahl's invention ('077), as noted above, was never asserted against it. Nor were claims 1-6 in the patent in suit ('879) infringed, they being the claims which describe the "improvement" Lindahl subsequently made to the SANDBLASTER and for which he filed the second application, only later denominated a continuation-in-part in order to provide a legally sound *1237 base on which to rest the two claims in suit which were carefully phrased to read on the LIME TAMER. This was a legitimate maneuver but, as Smith points out, it constituted "willful" behavior on State's part, clearly the result of competition-stimulated hindsight.

Another statement in Conclusion 54 is that "Smith started manufacturing and selling its Lime Tamer heater *and continued to do so* after receiving notice of infringement without seeking the advice of a patent attorney." (Emphasis added.) One must split this double statement into its two components, because it is a bit of double-talk. If the conjunctive phrase "and continued to do so" is deleted, the statement is wholly contrary to fact since the LIME TAMER was made and tested in Texas and inspected by State's attorney in July of 1979 and Smith, it was stipulated, got its first notice of alleged infringement by the complaint filed in this action in May of 1981. The aforesaid conjunctive phrase refers, of course, only to what has occurred during this lawsuit, during which Smith has been amply supplied with the "advice of a patent attorney" who hoped, with considerable justification, to prevail on at least one of several issues, making his client's actions far from wanton, reckless, or in deliberate disregard for State's rights. *Aerosol Research Co. v. Scovill Mfg. Co.*, 334 F.2d 751, 758, 141 USPQ 758, 764 (7th Cir.1964). Indeed, at this point he may still be hoping, for this decision is not the absolute end of the road.

What we have just said applies equally to Conclusion of Law 55, another double-barrelled statement reading, in conclusion:

55. The totality of Smith's conduct, prior to and during this suit, demonstrates a willful, deliberate and flagrant disregard of State's patent rights and lack of good faith and, therefore, justifies a trebling of damages under 35 U.S.C. § 284.

We have to disagree. We can understand that the statement could be drafted by an enthusiastic winning plaintiff's counsel but the record in this case

simply does not justify its adoption by the trial judge, for reasons we have stated above. Until 22 days before suit, State did not *have* the patent in suit, although for a couple of years it had had the *uninfringed* '077 patent on the same heater. Until State got the '879 patent, 22 days before suit, Smith had a perfect right to make and sell its LIME TAMER, without question, because State had no "patent rights" which covered it. *Aerosol*, 334 F.2d at 758, 141 USPQ at 764. A patent has no retroactive effect. 35 U.S.C. § 271(a).

Since we have been unable to discern any justification for holding Smith's defenses against the patent in suit to have been frivolous, on either the issue of validity or the issue of infringement, we do not perceive any lack of "good faith" in defending the suit and therefore we do not feel that what Smith had been doing while the suit was in progress is to be given any weight in determining "willfulness."

This court, in discussing the willfulness issue in the context of awarding attorney fees, recently said in *Stickle v. Heublein, Inc.*, 716 F.2d 1550, 1565, 219 USPQ 377, 388 (Fed.Cir.1983),

With respect to the court's finding of deliberate and willful infringement, more is necessary to support a finding of "willfulness" than that the infringing acts were not inadvertent. The court must determine that the infringer acted in disregard of the patent, that is, that the infringer had no reasonable basis for believing it had a right to do the acts. [Emphasis added.]

State, in its brief, relies on two recent cases in this court, *Central Soya Co. v. George A. Hormel & Co.*, 723 F.2d 1573, 220 USPQ 490 (Fed.Cir.1983), and *Underwater Devices v. Morrison-Knudsen*, 717 F.2d 1380, 219 USPQ 569 (Fed.Cir.1983). We distinguish them on their facts. In *Central Soya*, the plaintiff's patent had issued before the infringement was commenced with the aid of a plaintiff's employee hired away by the defendant. In determining willfulness, we said "It is necessary to look at 'the totality of circumstances *1238 presented in the case' * * *." Patent counsel had been consulted and gave two opinions: (1) there was a reasonable chance the patent could be held invalid; (2) infringement could be avoided by following certain procedures which the defendant, for a long time thereafter, took no pains to follow. In *Underwater Devices*, the infringer had actual notice of plaintiff's patent rights before the infringement began. The notice was by letter offering a license

under the patent before any infringement took place and defendant chose to proceed without a license. We affirmed the district court's finding of willful infringement, saying:

Moreover, M-K did not receive the opinion of its patent counsel until * * * after the infringement had commenced and even after the complaint for the instant case was filed. [717 F.2d at 1390, 219 USPQ at 576.]

After the oral hearing in the case at bar, counsel for State called our attention by letter to a third case, which had been cited in our opinions in both of the above cases, *Milgo Electronic Corp. v. United Business Communications, Inc.*, 623 F.2d 645, 665, 206 USPQ 481, 498 (10th Cir.), *cert. denied*, 449 U.S. 1066, 101 S.Ct. 794, 66 L.Ed.2d 611 (1980). Looking at the "totality of circumstances" in that case and comparing it with the facts here, we distinguish it also on its facts. Although the patents had not issued in *Milgo* before the copying began, the distinction is that in *Milgo* there was a most elaborate and detailed copying ("slavish copying" according to the trial judge) of complex electronic circuitry in a "modem" by a corps of engineers working in secrecy over a period of a couple of years to pry loose the secret of Milgo's inventions (623 F.2d at 652, 206 USPQ at 486). Because, as explained above, Smith did not copy State's structure, the fact situations are quite different. *Milgo* is not a compelling precedent.

For the foregoing reasons, we reverse the holding below that infringement was willful, etc., as stated in Conclusion 55. This removes the court's only asserted basis for exercising its discretion under § 284 to treble damages, which is, therefore, also reversed.

Attorney Fees

[7] The district court's award of attorney fees was contained in its Conclusion of Law 56, as follows:

56. For the same reasons, this is an exceptional case justifying an award of reasonable attorneys' fees to State within the meaning of 35 U.S.C. § 285.

The "same reasons" being those given for finding infringement to have been willful, which we have reversed as without support in the record, we disapprove that ground for holding this case to be exceptional within the meaning of § 285 and reverse the award.

When the patent statutes were first amended to provide for the discretionary award of attorney fees in 1946, the legislative history made it clear that their award was not to be an ordinary thing. The courts so construed it in the years following until the 1952 patent act made it specific by specifying in § 285 that the court's discretion was limited to awarding them "in exceptional cases." *Rohm & Haas Co. v. Crystal Chemical Co.*, 736 F.2d 688, 691, 222 USPQ 97, 99 (Fed.Cir.1984). See 8 *Deller's Walker on Patents* § 760 (2d Ed.1973); D. Chisum, *Patents* § 20.03[4][c] (1981). Merely losing on the defenses of invalidity and non-infringement is not enough to make a case exceptional. As this case now stands, we see no

ground on which to hold that it is exceptional.

CONCLUSION

The district court's holding that infringement was willful, its trebling of damages, and its award of attorney fees to the plaintiff State Industries, Inc. are *reversed* and its Order of October 5, 1983, is otherwise *affirmed*.

Each party shall bear its own costs on appeal.

AFFIRMED IN PART and REVERSED IN PART.

END OF DOCUMENT

Antoinette Bush

From: Bruce.Jacobs@shawpittman.com
Sent: Friday, March 23, 2001 3:13 PM
To: abush@sso.org; nhardy@ictpc.com; jim.barker@fw.com; pmichalo@steptoe.com; chadwick@mitre.org
Cc: rdorch@fcc.gov; john.hane@pgtv.com; TScott@hunton.com
Subject: License Agreement



License between Pegasus and FC...



pic26630.pcx

This is a copy of an earlier email that Rebecca Dorch asked

be distributed
to you.

Rebecca,

The attached is a proposed license agreement from Pegasus, similar to the one the FCC executed with Northpoint. Pegasus can accept the same cover letter terms as were used in connection with the Northpoint license.

Please call me or Tom Scott (955 1685) or reply by email if you have any questions.

Thanks.

Bruce

(See attached file: License between Pegasus and FCC March 14.DOC)

(Embedded image moved to file: pic26630.pcx)

LICENSE AGREEMENT

This agreement is effective as of March ____, 2001, and is made by and between

PEGASUS BROADBAND COMMUNICATIONS, INC.

(hereinafter "Pegasus"), a corporation whose address is 255 City Line Avenue, Suite 200, Bala Cynwyd, Pennsylvania 19004, and

THE FEDERAL COMMUNICATIONS COMMISSION

(hereinafter "FCC"), an agency of the Government of the United States of America, having an office at The Portals, 445 Twelfth Street, Washington, D.C. 20554.

RECITALS

- A. Pegasus owns the entire right, title and interest in and to proprietary technology in the field of terrestrial communication using satellite frequencies, which proprietary technology includes know-how, trade secrets and a pending patent application (hereinafter "Pegasus Technology").
- B. Pegasus is an applicant before the FCC to provide terrestrial service in the 12.2-12.7 GHz Band using the Pegasus Technology.
- C. The FCC is to conduct an independent demonstration of the Pegasus Technology in order to comply with Section 1012 of H.R. 5548, which was recently enacted as part of the Omnibus Consolidated Appropriations Act, Pub. L. 106-553, 114 Stat. 2762 (2000) (hereinafter "Section 1012").
- D. Pegasus is willing to grant a license to the FCC for the use of the Pegasus Technology solely for the purpose of conducting an independent demonstration of the Pegasus Technology pursuant to Section 1012, under the terms and conditions set forth herein.

NOW, THEREFORE, IT IS HEREBY AGREED by and between the parties as follows:

- (1) Pegasus hereby grants to the FCC a royalty-free, nonexclusive, nontransferable license to use, and have used for it, the Pegasus Technology solely for the purpose of conducting or having conducted for it an independent demonstration of the Pegasus Technology pursuant to Section 1012 and solely in connection with the present application of Pegasus to the FCC.
- (2) The FCC accepts the license granted hereby, and acknowledges and agrees that :

- (a) The FCC holds no other license, express or implied, to the Pegasus Technology ; and
- (b) This license shall end on April 30, 2001.
- (3) This Agreement shall be governed by and construed in accordance with the laws of the District of Columbia

IN WITNESS WHEREOF the parties have caused this Agreement to be executed by their duly authorized representatives, effective as of the date first set forth above.

**PEGASUS BROADBAND
COMMUNICATIONS, INC.**

**FEDERAL COMMUNICATIONS
COMMISSION**

By: _____

John Hane
Pegasus

By: _____

FCC

Path: DOCSOPEN\WASHINGTON\03253\57132\000005\4f3802!.DOC
Doc #: 206202; V. 2
Doc Name: Alternative 1-License between Pegasus and FCC
Author: Yarnell, Scott, 03253

CERTIFICATE OF SERVICE

I, Shannon Thrash, hereby certify that on this 20th day of April, 2001, copies of the foregoing were served by hand delivery* or first class United States mail, postage prepaid, on the following:

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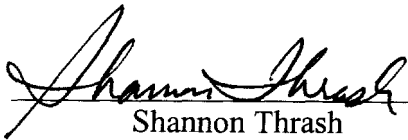
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